MACHINE DESIGN

PARTS • MATERIALS • METHODS • FINISHES

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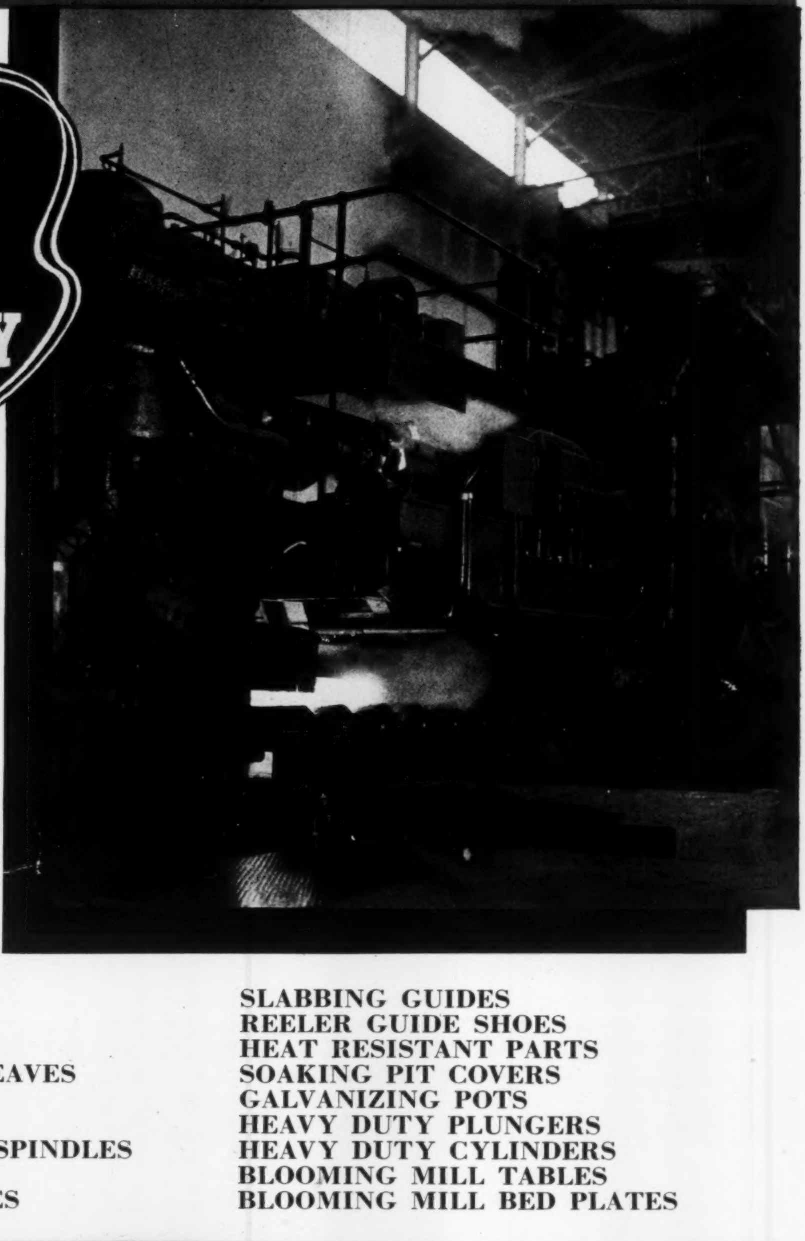

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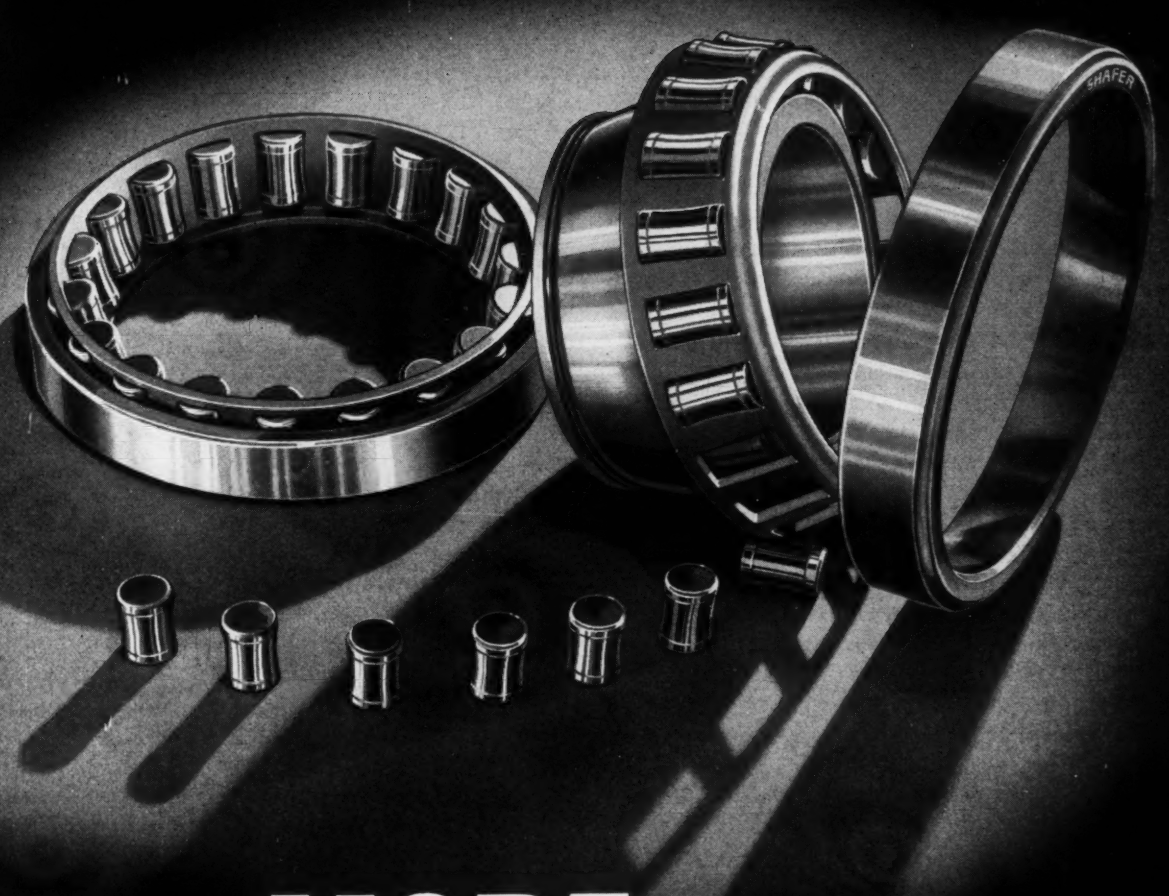

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Topics

THOUGH not the fastest, largest or most costly airplane ever built, a new four-motored land transport is making its appearance this month to which many superlatives may be applied. Of different design than the commercial transports which have been flying America's airways for the past five or six years, the DC-4 made by the Douglas Aircraft Co. will boast a tricycle retractable landing wheel arrangement which will enable the huge 32½-ton plane to "land flying into the ground," will keep it in a flying position with tail up when parked. The four motors of the DC-4 will produce 5600 horsepower, more power than that of many locomotives, propel the airplane at 240 miles an hour, and give it a surface ceiling of 22,900 feet. Eleven independent radio transmitters and receivers will assure constant communication between the airplane and ground. For passenger comfort there are steam heating, air conditioning, running water and electric cooking apparatus. The last word in aircraft design, DC4's are expected to displace the two-engined models used on most airlines today, set a new standard in aircraft transportation.

◆ ◆ ◆

Industrial designers, known more accurately but less popularly as "machine stylists," have unquestionably performed a needed and worthwhile service in dressing up machines to give a pleasing appearance. Credit is due them for the transition of machines from the eyesore category to things of beauty. They are doing a good job and we hope they continue, but we fear certain machine manufacturers are being temporarily hypnotized by the words "industrial designer." These companies are calling on the stylists who work so well with flowing contours and harmonizing colors to add a few flourishes to an outmoded design and try to make it the selling sensation of the year. In fact we have observed machines, the same basic model that has been produced for years, advertised as radically new because paint has been striped along the corners! It's time to call a halt. Redesign, coupled with styling, has a definite place in stimulating sales and we hope these will not be retarded by the unsound technique that lately has put in an appearance.

◆ ◆ ◆

Importance of concentrated design thought upon seemingly unimportant details was brought out by E. W. Brinkman of the Davenport Machine Tool Co. during the recent meeting of the Machine Shop Practice division of the American Society of Mechanical Engineers at Rochester, N. Y. Production time per piece in a multiple screw machine is approximately that of the longest single operation, ordinarily the cutting-off step. Mr. Brinkman described a simple attachment involving an auxiliary spindle mounted opposite the cutting-off spindle and driven in the same direction and at the same speed as the work spindle. This auxiliary spindle is provided with chuck equipment by which the work is grasped before it is severed from the bar stock. In this manner it both supports and drives the work, not only during the cut-off, but also during the operations subsequent to cutting-off. More important than the improving the quality of the work and the doing away with "second operation" rehandling, this design allows feeding the cut-off tool 50 per cent faster than under conventional conditions. Thus, the productive speed of a costly and highly refined machine is increased by almost 50 per cent—a result which no amount of major redesigning of the machine could have accomplished.

◆ ◆ ◆

Quartz, which looks like glass and is in fact a variety of glass, is the last material most of us would use to make a spring. Scientists of General Research laboratories, however, find quartz unexcelled as a spring material for making fine measurements, the *New York Times* reports. Quartz springs do not rust and are unaffected by humidity. Steel springs begin to lose their temper at about 500 degrees Fahr., but quartz springs lose their temper only at temperatures so high they are seldom attained. Springs made of quartz will detect a weight variation as small as one milligram and, after stretching, return to exactly the original point of rest. These springs are used in coil form and are made by winding a quartz thread about six one-thousandths of an inch in diameter over a mandrel when the thread is heated to 1800 degrees Fahr.

◆ ◆ ◆

A boost for centrifugal casting is likely to be created by the experimental developments taking place at Ford Motor Co. So far, experiments have

(*Concluded on Page* 87)

MACHINE
DESIGN

It Works While You Play—Through Timing Device

By Karl M. Wise
Chief Engineer, Bendix Home Appliances, Inc.

SIMPLICITY and automatic operation are more and more becoming requisite in today's machines. Housewives and others who might be termed direct consumers have very definite tastes in this direction, and it is to meet this demand that designers of machinery such as household equipment, store and office machines, etc., are giving special consideration to ease of control, automaticity and styling.

In few cases is this more apparent than in the design of the Bendix home laundry, illustrated in *Fig.* 1. Of revolutionary design in

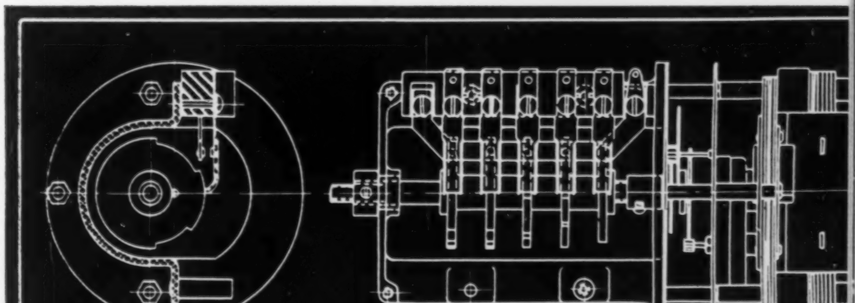

Fig. 1—(Left, Above)—Unit appeals immediately from standpoint of compactness and general appearance. Fig. 2—(Above)—Drawing shows timing device for controlling operations automatically

many respects, this washer operates automatically through the functions of soaking, washing, tumbling, rinsing, spraying and extraction. A time control device, discussed later, governs all of these operations, and the only attention needed is to set this control—after the soak period—to the necessary number of minutes it is desired to wash the clothes as governed by their condition or the type of fabric.

As will be noted from the drawing in *Fig.* 3, the washing cylinder in this machine is mounted horizontally. Clothes are fed in through the door at the front of the unit, and water (whether for soaking, washing or rinsing) is later turned on automatically and delivered through a spray nozzle so located as to aim directly at the clothes as they rotate with the cylinder. The water changes after each phase of the washing and rinsing is completed, passing through a pump and being discharged through the drain hose.

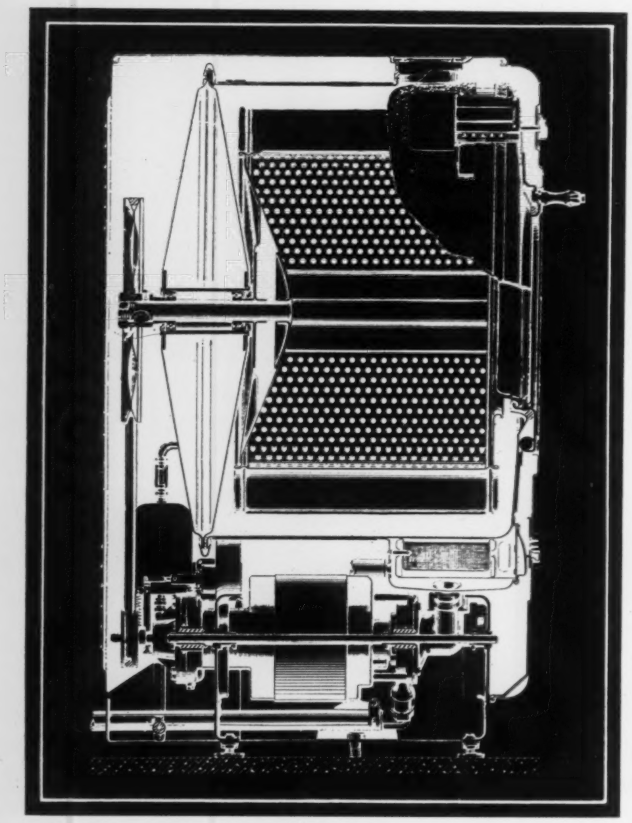

Fig. 3—Motor, pump and two-speed gearbox are pivotally mounted in rubber bushings

Because the time control switch, *Fig.* 2, is the basic element in the operation of the laundry, any discussion of the design of the machine necessarily centers around this unit. The switch is a comparatively simple device involving a synchronous electric clock and a system of five cams and corresponding contact fingers which control their electric circuits at the proper intervals. No. 1 cam, which comes into operation upon manually turning the time control knob, completes the electric circuit to the time clock and the electric motor. Momentarily, after the motor starts, the fingers on a hot water cam and a cold water cam contact and complete the electric circuit to the solenoid-operated inlet valves (one of which is shown in *Fig.* 4) as well as to the thermostat for controlling water temperature.

Operation of the bimetal thermostat is noteworthy in that the hot water valve remains open throughout the time water is being delivered, and the cold water valve only opens as and when necessary to reduce the temperature of the water. This cold water valve may open and close with machine gun rapidity, or infrequently, depending upon the temperatures and pressures of the water. The hot and cold water are passed through a mixing chamber before being used, to prevent surges of hot or cold water passing on to the fabrics to be washed.

A float chamber and float switch are utilized to determine and maintain the correct level of water in the tub. Operation of the float switch, which is in series with the inlet valve circuit, governs the opening and closing of the inlet valves.

When the "soak" period, during which the machine runs at 59 revolutions per minute, nears completion, the time control advances and opens the drain valve which is actuated by a solenoid in the same way as the inlet valves. Dirty water passes from the tub to the drain and the fabrics in the laundry are free to tumble and become aired prior to the washing cycle. The time control then shuts off (at a maximum of 14 minutes since started) and all electric circuits are broken until the control switch is set manually for the number of minutes required (5, 10, 15, or 20) for the washing cycle. After this the operation of the timer, inlet valves, thermostat, mixing chamber, float, float switch, drain valve and water pump is the same as during the soak period.

Selector Switch Is Utilized

In order that the temperature of the water shall be correct for the fabrics being washed, a "selector switch" is provided. This switch operates on the thermostat to allow either lukewarm water at 106 degrees or the maximum hot water in the heating tank to pass through to the washing cylinder.

Three rinse periods automatically follow the wash period, interspersed with extraction of water from the fabrics during which the cylinder is revolved at a speed of 327 revolutions per minute as compared to the washing speed of 59. The drain valve then closes, the timer shuts off the motor, all other electrical circuits are broken and the fabrics are ready for removal from the laundry.

To obtain the two speeds of the cylinder a gearbox is mounted integrally on one end of the motor, *Fig.* 5, which incorporates a solenoid-operated multiple disk clutch and an overrunning clutch. Ordinarily the drive is taken through the small gear on the extension of the motor shaft to the large gear on the shaft carrying the V-belt drive pulley. When the extraction speed of 327 revolutions per minute is required at the cylinder the time control energizes the clutch solenoid which in turn actuates the multiple-disk clutch. This passes the drive through the other pair of gears and the first pair is thrown out of action by release of the overrunning clutch.

Helix Actuates Overrunning Clutch

This latter clutch is not of the more or less conventional roller type, but operates by means of a multiple-lead helix on an adaptor keyed to the belt pulley shaft. Corresponding helical grooves are cut in the bore of the clutch plate and when the speed of the adaptor exceeds that of the plate, the plate moves sidewise from the slow speed gear and is disconnected from it. A driving key on the side of the plate engages a keyway on the gear when the two again come into contact to provide the slower cylinder speed. The clutch plate and gear, as well as the other gears and the multiple-disk clutch, can be seen in the drawing, *Fig.* 5.

Lubrication packing seals are used to good effect in the design of the laundry, one of these being mounted where the belt pulley shaft extends through the two-speed gear housing, and two others on the washing cylinder shaft adjacent the antifriction bearings, *Fig.* 3. The seal nearer the cylinder not only retains lubricant in the bearing but excludes water from it.

Every effort has been made to reduce the possibility of noise in operation. Rubber is used, for instance, for the mounting of the motor assembly pivot, *Fig.* 3. Tension on the belt is maintained automatically by weight of the motor unit, pivoted as shown.

Selection of materials also has played a major part in the design of the machine. Inlet valves, as shown in *Fig.* 4, are of stainless steel with valve seats of chloroprene rubber. The valve body itself, in which both hot and cold water valves operate, was formerly built up as an assembly of five parts but now is a single bronze forging which can be produced at considerable saving in cost. Cast iron is used for the housing of the two-speed gear, and heat resistant glass for the door in front of the laundry unit.

In the fabrication of the washing cylinder it was found expedient to utilize sheet zinc for the perforated portion of the cylinder. Galvanizing would be unsuitable for this part due to the perforations, but it is used for other sections of the cylinder.

Stamped and drawn frame members supporting the entire structure are spot welded together and enclosed within a cabinet to produce a machine that is highly pleasing in appearance. Porcelain enamel finish is used for the top section of the cabinet and white lacquer for the balance. As can be seen from the illustration in the head of the article, this Bendix Laundry need not by any means be relegated to the basement but if desired can readily take its place in the most up-to-date and lavishly-furnished kitchens.

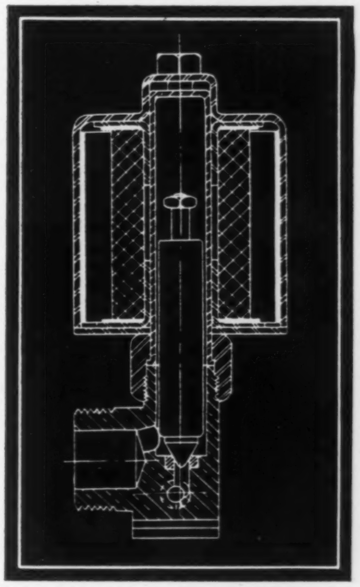

Fig. 4—Solenoid-operated valve is of stainless steel with valve seat of chloroprene rubber. A bronze forging is used for valve body

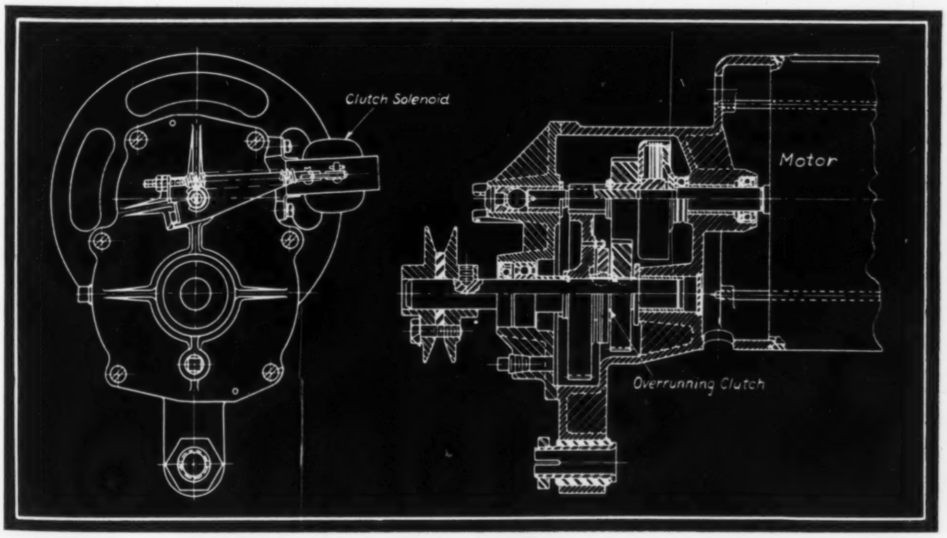

Fig. 5—Two-speed, solenoid-operated gearbox utilizes overrunning clutch and multiple-disk clutch for speed changing

Scanning THE FIELD FOR Ideas

WITH the entry of non-precious chrome alloys into the field of mechanical dentistry, technicians in that field have found themselves faced with new problems in the grinding, polishing and "rubber wheeling" of bridges made from these modern dental metals.

Designers at the Dumore Co. have now met this situation through the development pictured in *Fig.* 1. This small bench-type grinder has a motor with dynamically balanced armature which operates equally well on alternating or direct current and which develops speeds ranging from 20,000 to 23,000 revolutions per minute. This gives the required peripheral speed to the small wheels used on the work.

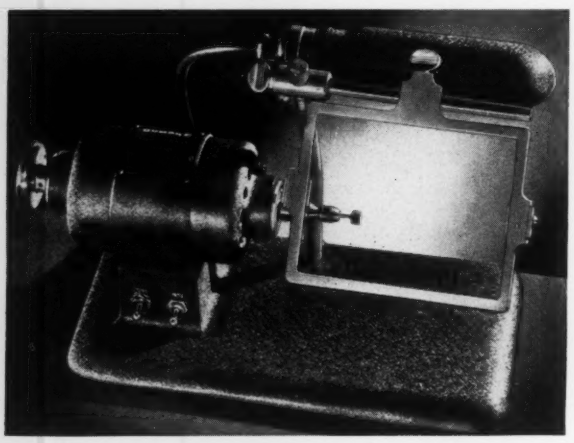

Fig. 1—Grinder designed for latest chrome dental alloys attains 23,000 revolutions per minute

Worthy of note is the effective manner in which a work light has been incorporated into the design, in conjunction with an adjustable safety glass eye shield.

Railcar Has Pendulum Suspension

SUSPENSION of a railway car body above rather than below its center of gravity is one of the revolutionary departures from standard practice embodied in a new type of passenger car which has recently been placed in test service on the Atchison, Topeka & Santa Fe harbor district line near Los Angeles.

Through courtesy of the Lincoln Electric Co., a photograph of one of the welded steel trucks of this "pendulum" type car is presented herewith as *Fig.* 2. The car body, which is of streamline design, is supported at points high up in its sides on relatively soft vertical coil springs mounted on the pedestals on the truck. These springs are out of sight, being housed in pockets in the streamlined "skin" of the car, which incidentally sweeps downward and inward, close to the rails.

According to reports on the tests, the body of the car has the effect of "floating" on the coil springs, which allow for all necessary truck motion as well as providing smooth riding qualities. Any tendency toward body roll when rounding curves is said to be in direct contrast to that of a conventional car. In other words, this "pendulum" car actually "banks" on the curves. This allows passengers to stand and walk with unusual ease and a feeling of stability while the car is traveling at high speed.

The trucks are arc welded from plates of high tensile steel and all welds are stress-relieved. Stiffness and rigidity are assured by welding in stiffeners, of which a number can be seen in the illustration. End trucks, which are of 9-foot wheel base, weigh 8800 pounds, while the 12-foot articulated trucks weigh 10,900 pounds. The latter are made separable so that cars can be uncoupled, thus providing flex-

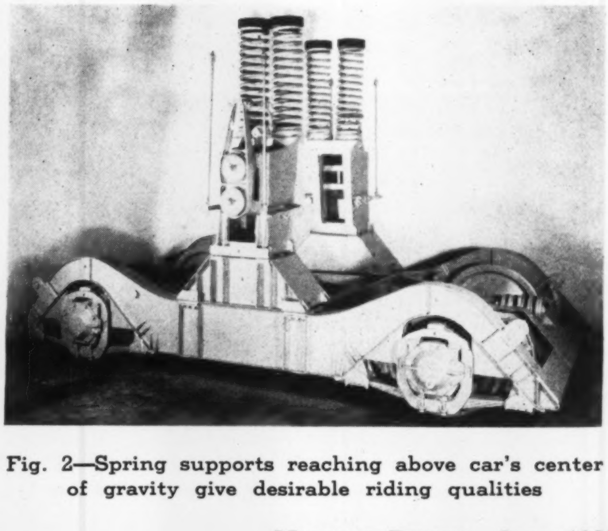

Fig. 2—Spring supports reaching above car's center of gravity give desirable riding qualities

ibility in the make-up of the train. The weight of the new car is approximately one-sixth that of the standard passenger car with six-wheel trucks.

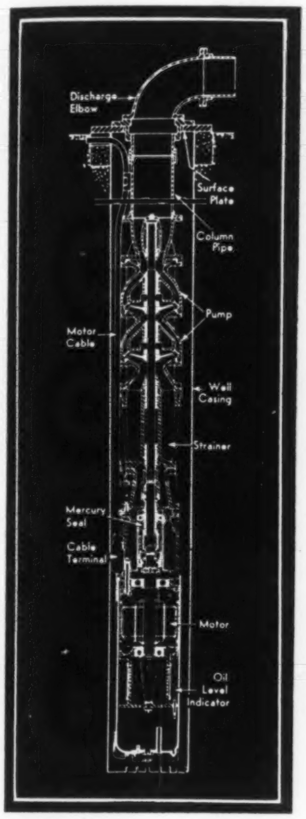

Fig. 3—This unusually compact deep well pumping unit has its turbines located above a submerged driving motor. Supported at the lower end of the discharge pipe, the only other surface connections required are the power cable and an oil tube — the short drive shaft being self-contained within the unit

Design and construction has been carried out by Courtlandt T. Hill. Associated with him is William E. Van Dorn, engineering research associate at the California Institute of Technology and inventor of the "pendulum" system of suspension.

Motor Drive Is Submerged

REVERSING the usual arrangement of turbine bowls and driving motor, the submersible deep well turbine pump illustrated diagrammatically by *Fig.* 3, above, has its motor at the bottom. This pump is a development of the Byron Jackson Co.

The motor is small in diameter but unusually long, while the shaft which drives the turbines is unusually short for a deep well pump. Although operating submerged in the well water, the liquid pumped does not come in contact with any electrical parts or motor bearings.

These are enclosed in an oil-filled case with a mercury seal at the point where the shaft passes out at the top. Water is sealed out at the top by mercury in a rotating cup attached to the motor shaft. Around the shaft is a cylindrical sleeve, of which one end is attached to the motor casing while the other end is submerged in the mercury. Thus the water and the motor oil are sealed off on their respective sides.

The motor is of squirrel-cage induction type, its rotor being carried on two ball bearings. One of these is of radial thrust type to take both the small weight of the rotary parts and the hydraulic load. The other is of radial type and its chief function is to center the rotor. A high dielectric oil circulates through the entire windings at all times.

It will be noted from the diagram that the pumping elements and the motor constitute a compact unit which is attached to and supported by the discharge pipe. A submarine armored power cable and a small copper oil tube are the only other connections between the pumping units and the surface of the earth. The first of these pumps has been running for several years in a well at a depth of 450 feet. Driven by a 50-horsepower motor it has consistently delivered its rated 250 gallons per minute against a 475-foot head without change or replenishment of oil.

Washes Buses Automatically

THE driver blinks his headlights at an "automatic laundry" as he drives in, whereupon water sprays, revolving brushes whirl, and in 40 seconds the sides, windows and roof of the bus have been washed free of dust collected during the day's run.

That in brief describes the action of the mechanism depicted by *Fig.* 4, below, which recently was installed by Leeds, Tozzer & Co. Inc., in a new garage of the City Transportation Co., Cincinnati.

As can be surmised by the first paragraph, the action is started and stopped by means of an "electric eye" controlled by the headlights of the bus. The revolving brushes are articulated so that they automatically accommodate themselves to the surfaces upon which they work. The manner in which they can follow the contours and in which they overlap each other, is plainly apparent in the photograph.

The horizontal attachments which work on the roof are counterweighted so that their brushes will

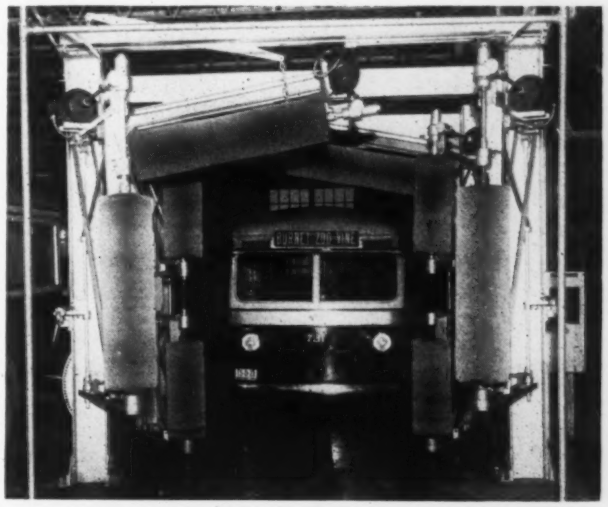

Fig. 4—After a treatment lasting 40 seconds, a clean bus emerges from this washing machine

oscillate up and down thus passing freely over ventilators in the roof.

Electrical equipment, including the "electric eye" and control panel, are of Westinghouse design. Six 2-horsepower motors of constant speed, splash-proof type are employed. They are of 220-volt, 3-phase, 60-cycle style, operating at 1750 revolutions per minute. The "electric eye" has a standard phototube housing with a 3-inch lens, and the panel carrying the necessary relays and switches for controlling the motors is enclosed in a steel cabinet.

Device Dries and Cleans Gases

DELIVERY of dry, clean compressed air, gas or steam often is a problem, inasmuch as the natural sweating of tanks and oil dripping from compressors, or a certain amount of steam condensation are almost unavoidable. To remove such polution at the point of use, the Textite Corp. has introduced a new type of separator of which a phantom view and section appear below as *Fig.* 5.

This unit, which is 10½ inches high by 6 inches in diameter and weighs 15½ pounds, effects cleaning by linear deflection, jetting, centrifugal force, capillary attraction and sudden expansion of the medium passing through it. There are no moving parts and construction is of rust-proof acid resisting materials.

Mounted one above the other within the pressure-resisting casing are three internally vaned elements through which the air, gas or steam must flow successively before issuing from the top connection. Each of these vaned elements sets up a rapid whirling movement in the material passing through. The effect of this is to project the moisture, oil and dirt outward from the center.

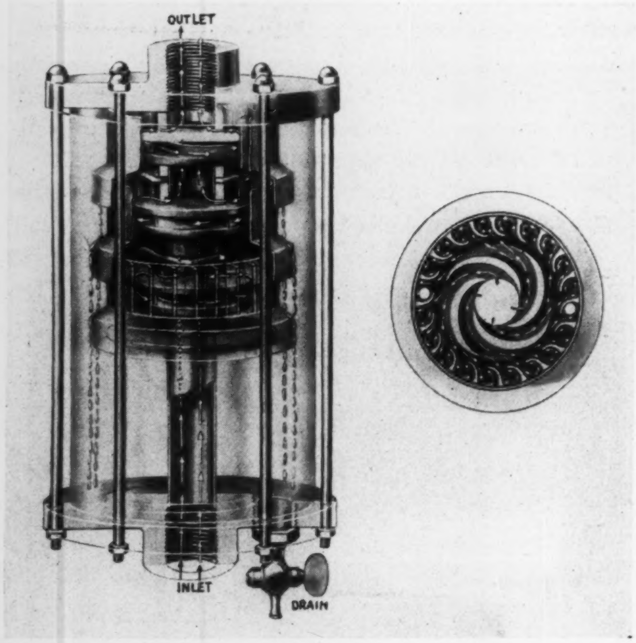

Fig. 5—Compressed air, gas or steam are dried and cleaned at point of use by this separator

At the same time the flow is caught by additional sets of vanes curved in the opposite direction and secured to overlapping sleeves within the housing. This reversal following the initial centrifugal action causes the moisture, oil and dirt to strike the inner surfaces of cups, from which the polution drips into a collection chamber at the bottom of the shell. Flow from the outlet therefore is clean and dry.

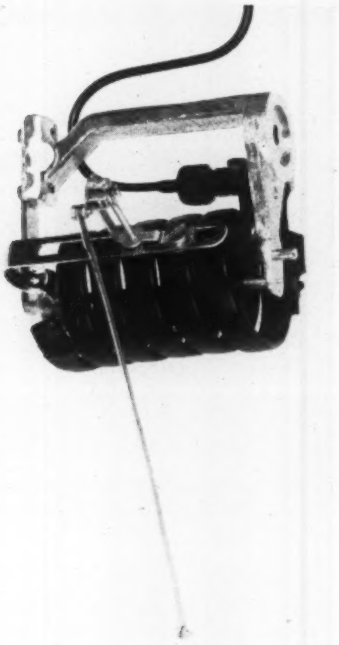

Fig. 6—To withstand modern high pressures, the helical of this pressure recorder is made of high tensile steel, heat treated after its ends have been welded

Redesign of Pressure Gages

MODERN high temperatures and pressures make demands on pressure gages which call for modern materials and methods of construction. This is true particularly of the flattened hollow helical spring which is the "heart" of that type of gage whose mechanism is shown in *Fig.* 6, above.

This is the "movement" of one of the latest pressure recording instruments developed by the Foxboro Co. The hollow helical spring is of heat-treated alloy steel, cadmium-plated and coated with a special flexible lacquer to resist corrosion. Prior to heat treating, one end is sealed and the other end is connected to the coupling member, by welding. The pressure line is connected to the helical by means of a compression fitting. This allows the line to be disconnected easily, for blowing out in case clogging should occur.

The gage operates through the unwinding effect on the helix due to internal pressure. Resulting motion is transmitted from its free end by a flexible strip to a central spindle, which in turn moves the pen arm adjustably mounted on a bracket carried by the spindle.

Change in "Function" May Constitute Invention

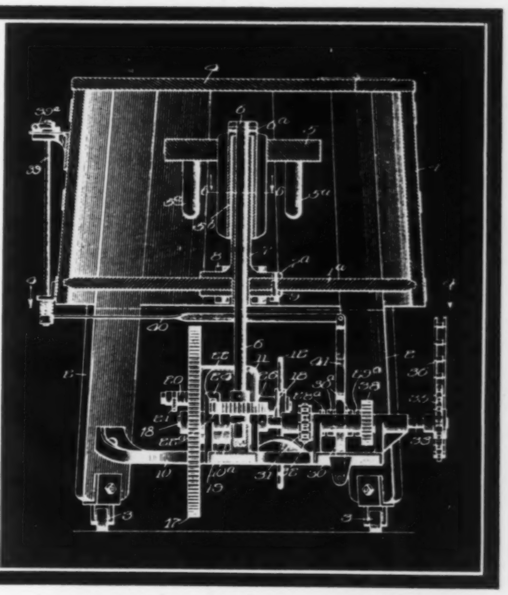

Fig. 1—By simply changing the location of the washing machine mechanism to eliminate projecting parts, a new result was produced which constituted invention

By George V. Woodling

IN THE design of machines many valuable improvements are made by omitting or adding a part or by changing the form or location of the structural elements. Cost of manufacture may be lowered by making two parts integral which formerly were separate, or the ease of assembly or operation may be facilitated by making a single part into two separate parts. Greater efficiency may be attained by applying the power at a different location in the train of elements of the machine. When such changes are made in the design of machines the question often arises: Are the improvements patentable?

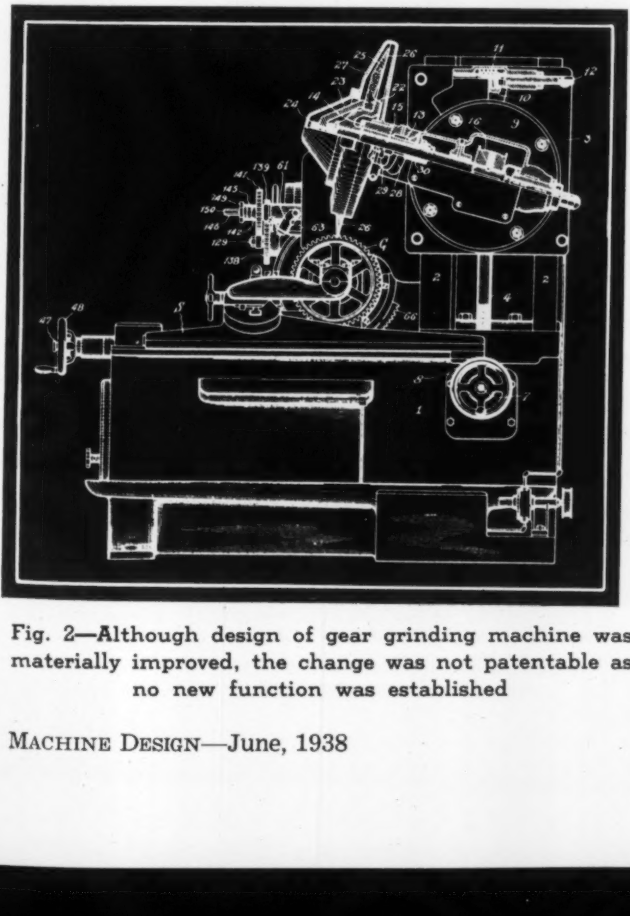

Fig. 2—Although design of gear grinding machine was materially improved, the change was not patentable as no new function was established

The general rule is that they are *not* patentable. Exceptions to the rule are invoked when the changes produce a new and different result. Thus, in the case involving the washing machine in *Fig.* 1, it was held to be invention to change the location of the entire operating mechanism to a position below and within the line of the tub. In prior devices the operating mechanism projected beyond the line of the tub and interfered materially with the operator. The Court found that a new result was produced by making a change in the location of the operating mechanism since the location brought about the elimination of undesirable projecting parts beyond the line of the tub.

There is no logical test to use as a guide to ascertain whether a new function is produced as a result of a change in the design of a machine. This is true because the advantages from a new function do not appear in the same form in all cases. The advantages may appear as an unexpected increase in efficiency, the elimination of fatigue on the operator, the regulation of erratic speed conditions, a reduction in damaging vibrations or the maintenance of uniformity in operation under widely fluctuating conditions.

The new function must be an unexpected one as

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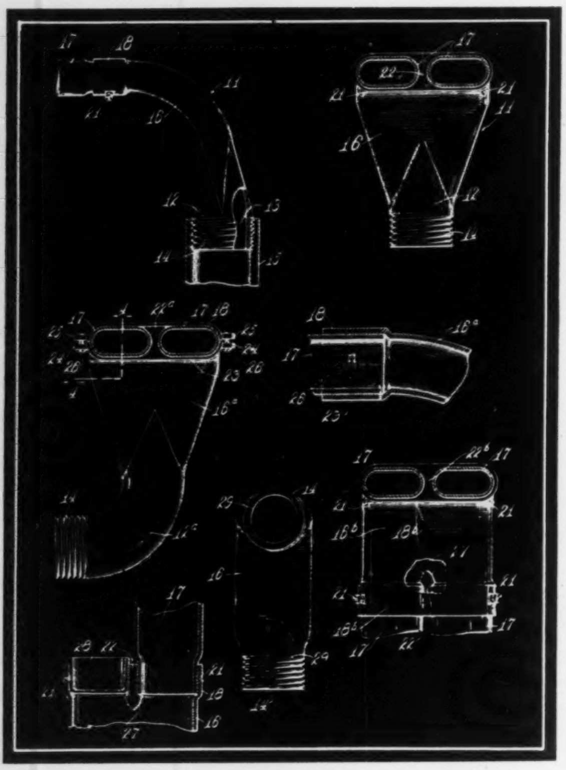


Fig. 3—By making curved conduit which would facilitate the wiring of buildings, the Court held this simple device to be invention

distinguished from one arising through engineering judgment. An interesting case, illustrating the point in which a Court decided the advantages arose from engineering judgment, involved the machine for grinding gear teeth shown in *Fig.* 2. The novel feature was a change in the application of the driving power from one end of the chain of elements to the other end. As illustrated, the gear tooth grinding machine comprises a longitudinally reciprocating table, a rotatable gear-holding spindle mounted thereon, and intermediate translating devices. By these parts the intermittent reciprocating revolution of the spindle causes the reciprocating longitudinal motion of the slide. The teeth in the gear are ground by generating a proper involute curve by the above described combination.

In earlier machines there were instances of the same combination, except that the power causing reciprocating movement was applied to the slide instead of to the spindle. Applying the general rule the Court found that the mere transposition of the driving power was not a patentable invention. The defendant argued strongly that the change in the location of the driving power produced a distinct benefit in that by applying the power to the spindle instead of to the slide, the danger of lost motion was materially reduced. Because of the high degree of accuracy required in grinding gear teeth, the elimination of lost motion was an important factor. The Court, however, found that the reduction in the loss motion resulted not from any new function but from the mere fact that the number of parts and accompanying clearances through which the power was transmitted were less and that this was the result of engineering judgment and not of inventive skill.

The making of a single piece into several parts or the designing in one piece of a device previously made of several connected parts, according to the general rule, does not involve invention. But it must not be inferred that simplicity bars invention. This is not true because the consolidation of parts may constitute a patentable improvement of a high order. Machine designers should remember that the general rule gives way if it can be shown the new device produces a new function. The recognition of a new function is sometimes a difficult task, particularly when the function is deeply hidden.

In searching for a new function the designer's vision should not be too highly concentrated upon the mere parts of the invention themselves. The difficulties encountered in the field in which the invention is used should be taken into account. This broadens the designer's perspective and enhances the opportunity of recognizing the creation of new functions in the machine. When viewed from the mere construction of the device itself, one would not ordinarily consider the curved conduit coupling for oval ducts shown in *Fig.* 3 as being a patentable invention. But when the vision is enlarged to embrace the novel use to which it is employed to facilitate the wiring of buildings, it appears patentable.

In modern buildings electric wires are carried in round iron pipes within the vertical walls to the room where they are to be used to what is known as a

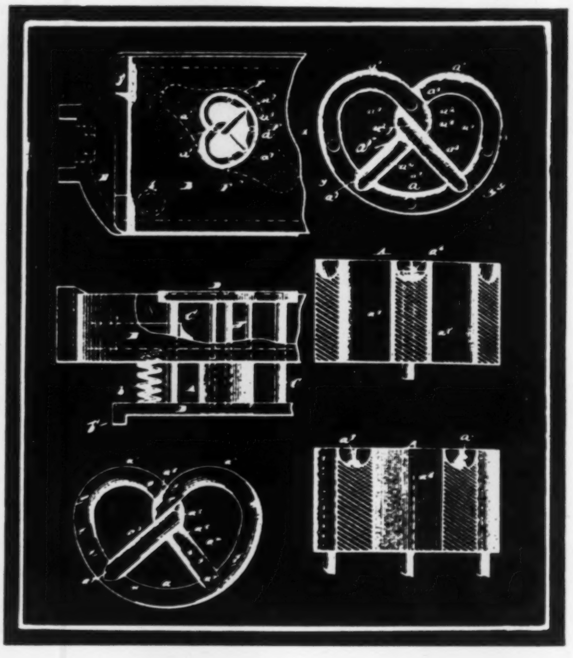


Fig. 4—Design of die to cut pretzels was not considered invention as no particular skill or inventive genius was required

wall box. These pipes are usually embedded in concrete. A section of the iron pipe, called a riser, extends from the wall box within the wall to a point near the ceiling. From this point the wires must be carried along the ceiling to a point where the light fixtures are to be placed. Drawing the wires from the wall box through the riser to the point near the ceiling is called fishing the wires. It is necessary to have a connection which will not only completely enclose the wires but also permit and facilitate the fishing of the wires. This connection is the integral curved conduit coupling shown in *Fig.* 3. As illustrated it comprises a curved conduit having oval ducts with a comparatively smooth interior surface gradually arched to facilitate the fishing of electric wires through it.

Utility Makes Device Patentable

Prior to this invention, several parts were required to do the same thing as performed by the integral casting. By making the several parts integral, the Court found that it prevented cement, plaster, and other dirt from entering the conduit and obstructing the passage of the wires. It was the utility which the integral device performed in the field that gave it patentable merits. Had this enlarged vision been overlooked it might have been considered an unpatentable invention.

Closely related to the problem of making a part in one piece is the problem of whether a change in form is patentable. These questions usually arise in connection with dies where it is required to shape or design a part to produce a given product. Ordinarily, it is considered in the field of mechanics rather than in the field of inventive skill to make a die of a certain configuration to give a similarly shaped product. Thus, it was held the pretzel cutter shown in *Fig.* 4 was not the subject matter of a valid patent because the alleged invention consisted merely in shaping the die to correspond to the shape of the pretzel which could be done easily by a mechanic.

Inventive Genius Found in Die Design

On the other hand, the die in *Fig.* 5 for shaping spiral macaroni was held patentable because in this die it was necessary to take into account other elements which the Court found were beyond the ordinary imagination of a skilled mechanic. As illustrated, the die for making the spiral macaroni is arranged to have two pins: A solid pin 22 at the entrance and a hollow pin 17. The dough is not only forced through the center of the hollow pin and out through the opening in its side but also forced through the opening provided outside of the hollow pin with a common exit which has in its center the solid pin for making a tubular form of macaroni instead of a solid spiral. These several passages provided in the die formed a compound opening. If the dough is not forced through the hollow pin but only down through the outside opening the result would not be a spiral. By forcing the dough through these compound openings the larger amount of macaroni goes through the hollow pin and out through the opening in its side with the common exit, and the macaroni is thus coiled as it emerges. It is the compound discharge aperture which constitutes the inventive idea and thus it was held to be patentable since it produced a new and different result from that produced by the prior devices.

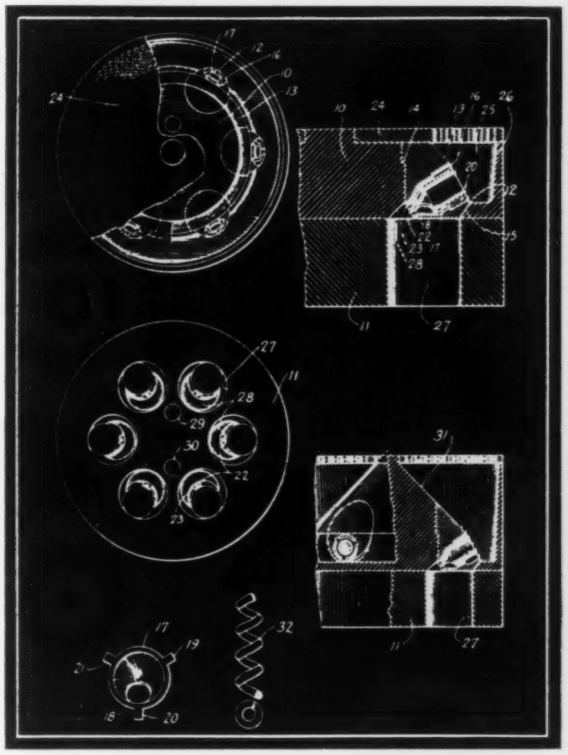


Fig. 5—The die for making macaroni in this machine was held patentable because its design was beyond the imagination of an ordinary skilled mechanic

The omission or addition of new elements are ordinarily not patentable unless a new and different result is produced. For example, if a machine can be so designed that it has fewer parts than it had before, and still perform all of the functions of a larger number of parts, it may be the subject matter of a valid patent. Reasons for this are that the elimination of some of the parts did not take away any of the functions performed by the larger number of parts. If the omission of the part is accompanied with a corresponding omission of function so that the retained parts do just what they did before in the old machine, then the omission is not patentable. The same reasoning applies when a part is added to an old machine. In all cases where a change is made in the design of machines, if the inventor can show convincingly that there is a new and different function produced he stands a good chance of proving that his ideas are the subject matter of a valid patent.

Compact Pump Adds Display Space in Gas Dispenser

By A. P. Hitzeman
Chief Engineer, Wayne Co.

IN A business where competition is keen, constant research and capable design are required to maintain a leading position for the product turned out. Engineering must be of a high order, developments must be kept well in hand until thoroughly tested, and fine appearance of the product must be maintained. These and other factors, including the assurance of dependable quality at moderate cost, have helped Wayne Co. to gain and hold an enviable reputation among the suppliers of gasoline dispensing equipment.

Recognition of the importance of fine appearance led Wayne engineers in 1934 to center their attention upon this factor. They secured the services of a firm of industrial designers to work out the matter of external appearance. The result was the Model 60, a pump which gained great popularity and is still being produced along with certain more recent models, including the Model 60 S here described. In lines and general appearance the latter is practically the same as Model 60, but, thanks to a new and radical design in the pump proper and in some other parts of the internal mechanism, there is room within the pump housing for a compact display cabinet. (See *Figs.* 2 and 3). No such cabinet has been available before except in special display models, wider and much more bulky.

Until recently the rotary vane pump has been the accepted type for gasoline delivering devices. The vane pump employed by Wayne has been quite satisfactory and is still supplied in the Model 60. Centrifugal pumps had not been thought suitable, partly because they required priming by a secondary pump which would add extra cost and complication. A design

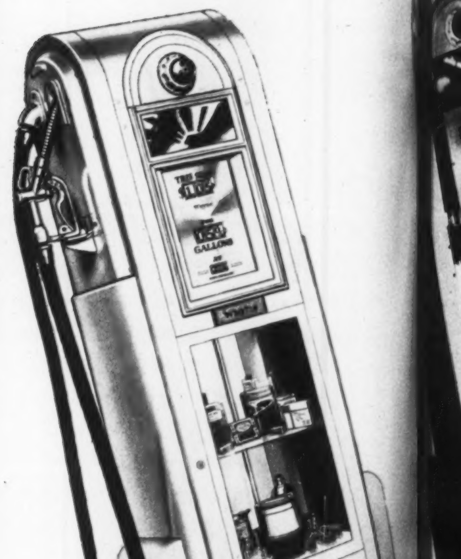
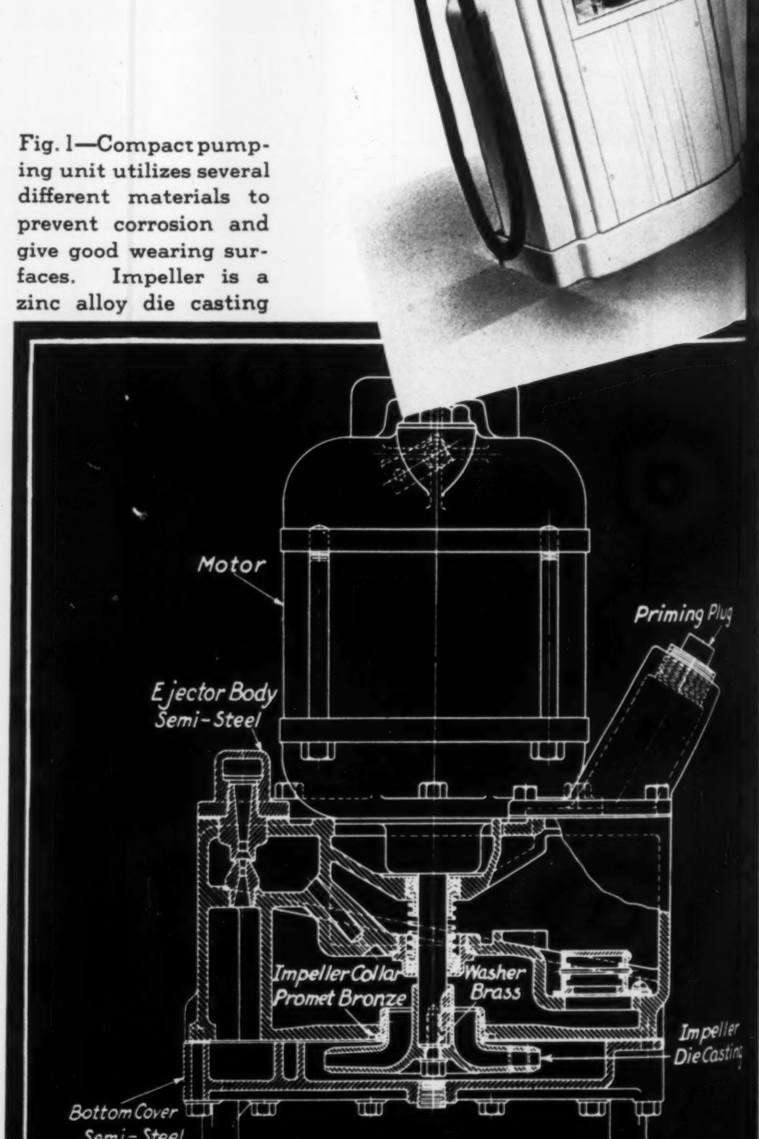
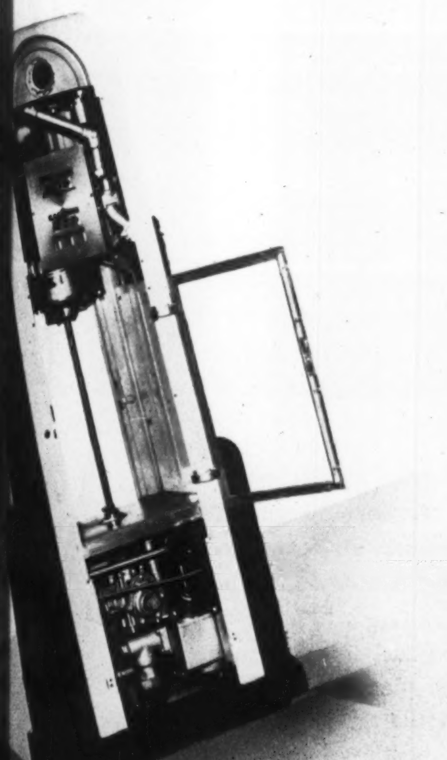
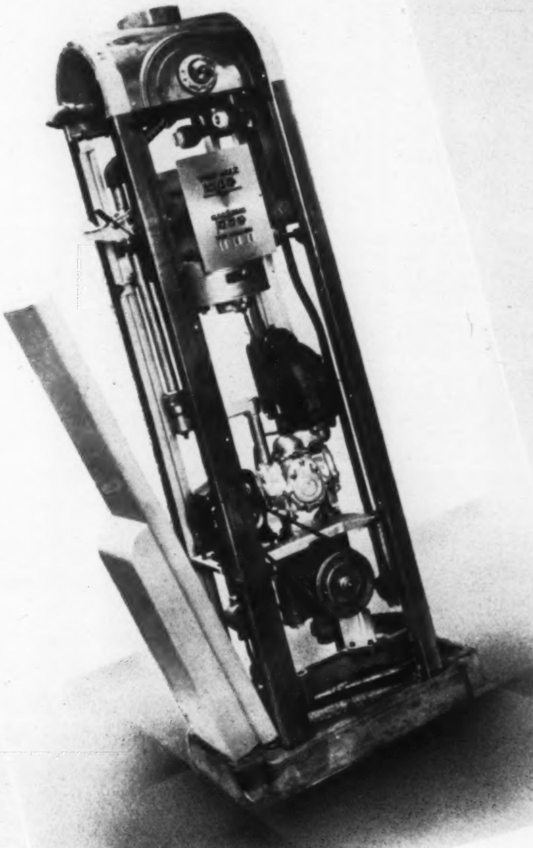


Fig. 1—Compact pumping unit utilizes several different materials to prevent corrosion and give good wearing surfaces. Impeller is a zinc alloy die casting







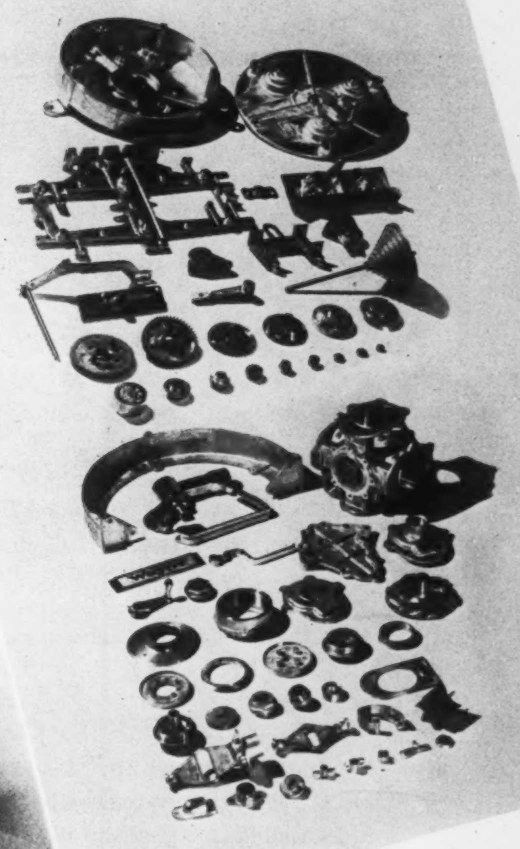


Fig. 3—Former method of placing pump and motor in gas dispenser is shown at left above. Directly above are many of the die cast parts used in pump and counting unit

Fig. 2—View at extreme left shows the adequate display space that is now possible with redesigned pump. Adjacent view depicts method of mounting pumping unit in base

which overcomes this fault and incorporates various other advantages has recently been worked out and introduced by Wayne after extensive tests.

Besides giving the valuable characteristics of centrifugal type pumps and without introducing the non-priming fault just mentioned, the centrifugal pump is compact, can be run at high speed in a direct drive, and offers important economies in manufacture. It has only one moving part and is economical in power requirements. Less power is required when by-passing than when delivering, contrary to that in vane types. In addition, in the form developed by Wayne, the separation of air and gasoline before the discharge can be metered accurately is accomplished automatically within the pump and does not require a separate unit for this purpose as with vane pumps. This makes for compactness and permits adding the display cabinet in space formerly required by mechanism, air separator, piping and various other parts.

In the current model the major units of the assembly include the centrifugal pump with integral settling chamber and direct-connected motor; a positive displacement meter produced largely from die castings in zinc alloy and described in detail in an earlier article (M. D., May, 1934); a computing mechanism including several die-cast parts, driven directly by the meter and comprising suitable change gearing (to take care of price changes); a housing formed largely from steel but including some die castings which contribute materially to appearance, and the flexible hose with its outlet control nozzle valve. There are, of course, many control and accessory items, including piping, lighting units, dials, name plates and the like, seen in the accompanying illustrations.

Aside from the arched die-cast top the housing is built up mostly from rolled steel sections and inexpensively formed sheet steel panels. A high grade cast-iron base is provided. The entire exterior is finished in enduring synthetic enamel, usually in more than one color and often with attractive striping, the colors and decoration being specified by purchasers

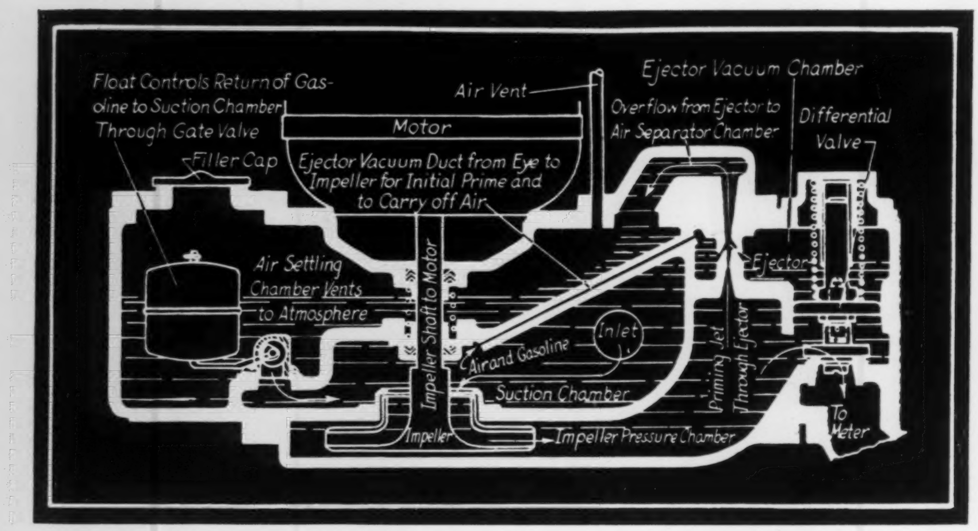

Float Controls Return of Gasoline to Suction Chamber Through Gate Valve
Filler Cap
Air Vent
Motor
Ejector Vacuum Duct from Eye to Impeller for Initial Prime and to Carry off Air
Ejector Vacuum Chamber
Overflow from Ejector to Air Separator Chamber
Differential Valve
Ejector
Air Settling Chamber Vents to Atmosphere
Impeller Shaft to Motor
Air and Gasoline
Inlet
Suction Chamber
Priming Jet
Through Ejector
To Meter
Impeller
Impeller Pressure Chamber

Fig. 4—Principle on which the centrifugal pump operates is shown in this diagrammatic sketch. Air settling and suction chambers in which pump packings are located are never above atmospheric pressure, thus giving no cause for gasoline leakage

to fit in with their respective merchandising plans.

As will be seen from *Fig.* 2, right, the pump proper is within the housing. It is placed at one side next to the base with the explosion-proof driving motor flange mounted against its cast housing. Discharge, at the rate of 18 gallons per minute, is directly into the meter located just below the display cabinet and driving, by a shaft through the central tube, the computing device above the cabinet.

Gasoline Drives Turbine To Show Passage

Discharge from the meter is directly into a pipe passing up one corner of the housing and through the gasoline-measuring turbine body casting to the hose-connecting fitting near the top. Above the computer there is a cross shaft driven by the gasoline passing through the turbine body and carrying at each end of the shaft a spinner housed within a heat-resisting glass bull's eye. The spinners turn when the meter is operating and thus show when fuel is being delivered. Bull's eyes are held within tubular die castings which also form several other exterior fittings, some of them being plated. Dial plates are of aluminum sheet.

The drawing in *Fig.* 4 shows the principle on which the pump operates and various details of its actual construction are shown. High grade iron is used for the two parts of the main pump housing, but the impeller is die cast in two parts: The body portion and vanes as a one-piece zinc alloy casting and the disk in aluminum alloy. The minimum section thickness is 0.070 inch. Besides the impeller, the other parts of the pump die cast in zinc include the poppet valve body, a plunger follower, a valve cap, an impeller collar and a seal nut illustrated in *Fig.* 2, right. The pump shaft passes upward through a pair of chevron packings (See *Fig.* 1) urged in opposite directions by a spring. As the air settling and suction chambers in which these packings are located are never above atmospheric pressure, gasoline leakage is avoided. The impeller makes no metal-to-metal contacts and, in common with the armature, is dynamically balanced to avoid noise and vibration.

Initially, the pump housing is partly filled with fuel and thereafter can never be emptied unless a drain plug is purposely removed. In consequence of this and other features to be mentioned, no priming is required.

When the motor is started fuel in the impeller or pressure chamber is at once placed under pressure, the poppet valve leading to the meter being closed. Thus fuel is forced out through the ejector and overflows into the upper or air-settling chamber. In so doing it creates a partial vacuum in the chamber above a differential valve, the latter being above the poppet valve. This reduced pressure draws out any air or gas which naturally is released in the low pressure area at the "eye" of the impeller, and the gases subsequently enter the settling chamber where they pass out through the air vent. When a predetermined pressure is reached in the pressure chamber the differential valve is forced upward against its spring, lifting the poppet valve and permitting fuel to discharge through the meter (See *Fig.* 4). As long as the pump runs, however, some fuel continues to flow through the ejector, drawing off any air or gases which may enter with the fuel coming from the storage tank, the velocity at the impeller eye being low as is also the pressure at this point. A float and a valve operated by it control the return flow of gasoline, maintaining a substantially constant level in the settling chamber.

Because of the difference in areas exposed it requires about 20 pounds pressure to open the discharge valve but only some 12 to 14 pounds to hold it open when the pump is delivering. The pump will not build up sufficient pressure to open the discharge

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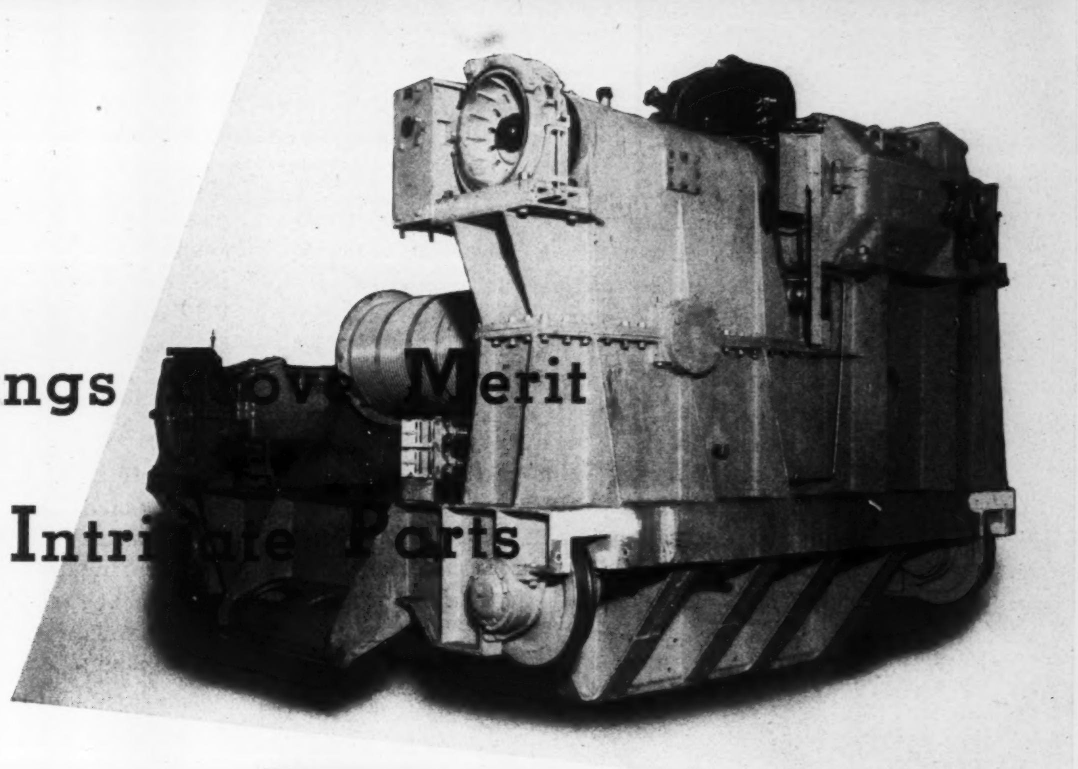
Steel Castings Prove Merit As Large, Intricate Parts



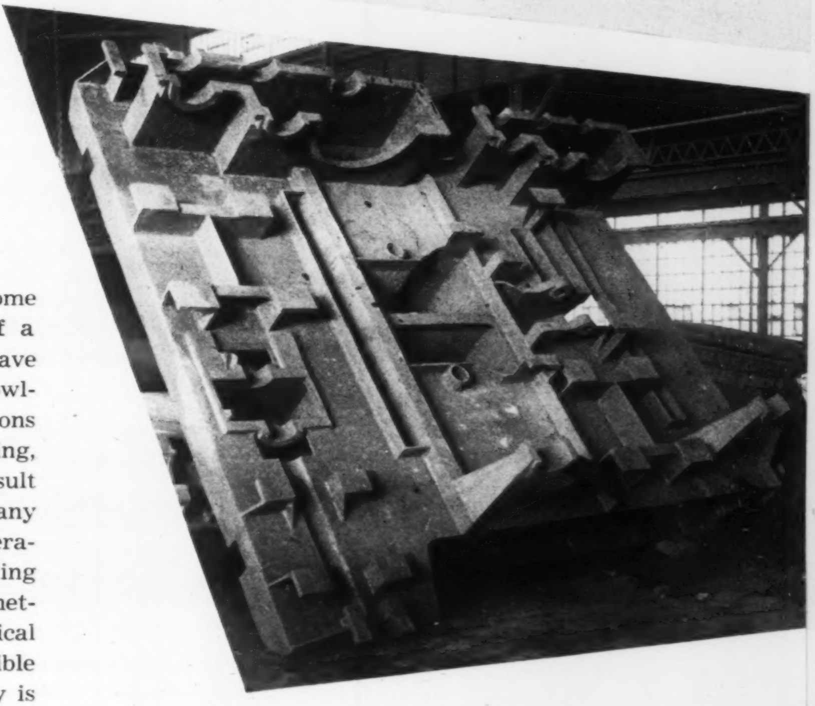


Fig. 1—Top—Crane trolley is cast steel

Fig. 2—Steel casting, section ⅝ inch

By F. K. Donaldson
Superintendent,
The Machined Steel Casting Co.

DURING the past few years, steel casting has become less and less of an art, and more and more of a science. Rule of thumb methods of molding have been replaced by methods which are based on exact knowledge of what will take place when various sized sections and shapes are cast into a one-piece structure. Gating, heading and chilling are better understood, with the result that ills formerly attributed to a lack of knowledge of any of these are being dissipated rapidly. The molding operation itself is becoming more highly mechanized, eliminating to an increasing extent the human element. Increased metallurgical knowledge makes available castings with physical characteristics which are suited to almost every possible type of design. All in all the intricate casting of today is a far cry from those produced in the not so distant past.

One of the most severely used pieces of equipment in the heavy manufacturing industry is the overhead traveling crane. Subject to vibrations and heavy stresses, these at many times magnified due to extreme overloading, this type of machine is an ideal proving ground for the various methods of construction. In this field the one-piece cast structure has demonstrated its value and dependability as an engineering material.

The trolley for a 20-ton soaking pit crane, shown in *Fig.* 1, has a one-piece cast steel base or chassis. This casting measures 14 feet 8 inches by 12 feet 2 inches by 6 feet 5 inches deep, and weighs 26,280 pounds. It was cast in ¾-inch section, a rather outstanding achievement in view of its depth of 6 feet 5 inches. In this casting, bearings, brackets and gear housings are cast as integral parts of the main frame. Permanent alignment of track wheels and gear centers are assured. Riveted and bolted brackets are of course eliminated, thereby doing away with something which has caused much service trouble in the past.

Consider also *Fig.* 2, which illustrates a one-piece cast steel trolley frame for a 75-ton crane. The overall dimensions of this casting are 15 feet 7 inches by 15 feet 4½ inches by 4 feet 2 inches, and its section is only ⅝-inch. This casting, which weighs 21,600 pounds, ably demonstrates that it is possible—in the modern steel foundry—to cast structures of large surface area successfully in light metal sections.

The one-piece steel casting, particularly that of uniform section, is a more or less homogeneous entity in its crystal structure instead of being composed of a heterogeneous mixture of component parts. It is free from what may be termed "directional properties" caused by distortion of the crystal structure as cast. Its properties radiate equally in all directions. For this reason cast steel is not surpassed as an engineering material where strength and particularly rigidity are of prime consideration. In cases of complicated arrangements of moving parts in which absolute and permanent alignment of bearings is necessary, the superior rigidity of the steel casting is a factor assuring success.

The large one-piece trolley castings just described were made for the Alliance Machine Co., Alliance, O., who built the cranes on which they were used. In the past fifteen years this company has built and placed in service approximately 700 cranes on which such one-piece cast steel trolleys were used. To date *there has not been one single failure.* This record amply demonstrates the dependability of these intricate cast structures under most severe service requirements, and accounts for the fact that engineers and operating heads in many of the country's largest mills insist on cast steel construction, not only for trolleys but also for trucks, end carriages, yokes, drums and other highly stressed units of crane construction.

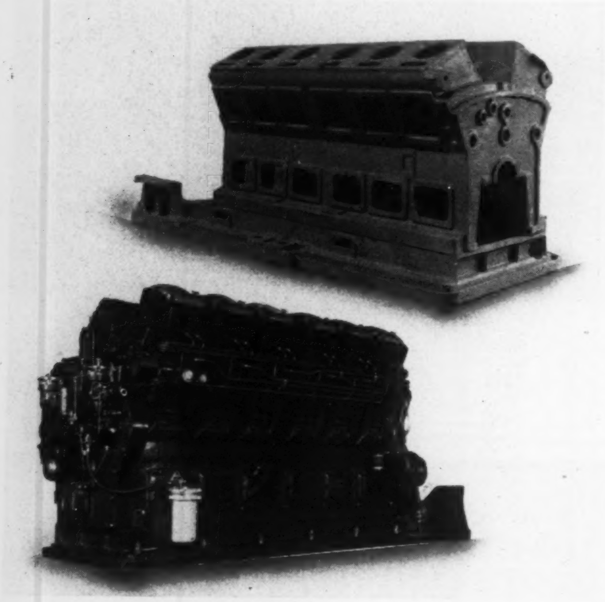


Fig. 3—Cylinder block and base of this diesel engine are steel castings shown at upper left

Back in the 1890's, when Dr. Rudolf Diesel developed the engine which bears his name, not even the most visionary could have foreseen the tremendous expansion in applications of diesel power which has taken place in the last few years. Buses, trucks, excavators, draglines, industrial power plants, pumping equipment, industrial locomotives, and now the power plants for the new streamline passenger trains, all give ample evidence of the versatility of this most modern of power producers. A beautiful example of this type of power unit is the new 500 horsepower V-12 engine, built by the Cummins Engine Co., Columbus, Ind., and depicted in the lower view, *Fig.* 3. The cylinder block for this engine, and the base on which it is mounted, both are steel castings. These castings appear in the upper view, *Fig.* 3.

In the first castings which were made, the main oil line, which extends the full length of the casting, was cast in as an integral unit, using seamless steel tubing of approximately two inches inside diameter. In the latest casting made, the lubricating tubes to the crankshaft bearings of ½-inch inside diameter seamless steel tubing, permanently attached to the main oil line, likewise were cast in. This eliminates the difficult machining operation of drilling these long, small diameter holes.

Diesel Casting Is Intricate

This cylinder block is one of the most intricate castings ever produced by a steel foundry. Section thicknesses vary from 5/16-inch in the wall sections comprising the water jacket to over 3 inches in such locations as the crankshaft bearings and the pads for the bearing stud bolts. The mold setup presents a complicated and interesting problem, being comprised entirely of cores, which must be gaged and calipered to approximately 1/64-inch.

In future castings, lateral lubricating tubes to the camshaft bearings will also be cast in, thus making practically the entire lubricating system one component unit. Not only will this eliminate difficult machining operations, but it will also prevent any possibility of leakage in the oil system. It is only through use of the cast structure that such procedures, with all their attendant advantages, are possible.

This cylinder block is an excellent example of the versatility of the cast steel structure. The various parts of the casting are made exactly to the shape and size required, with no alterations necessary due to fabrication difficulties. While it presented an extremely difficult foundry problem, close and sympathetic co-operation between designer and producer resulted in success.

After the pattern equipment has been made, duplicate castings of this intricate nature may be easily and economically produced. Pattern costs, in many cases, are found to be less than costs for jigs which are necessary for fabricated construction. In cases of duplicate orders, it has been found that very much quicker deliveries are possible with cast construction.

Steel castings, almost without exception, are subjected to heat treatment before shipment. Incidentally, they show very little tendency toward distortion in the heat treating process.

In the production of intricate cast steel structures,

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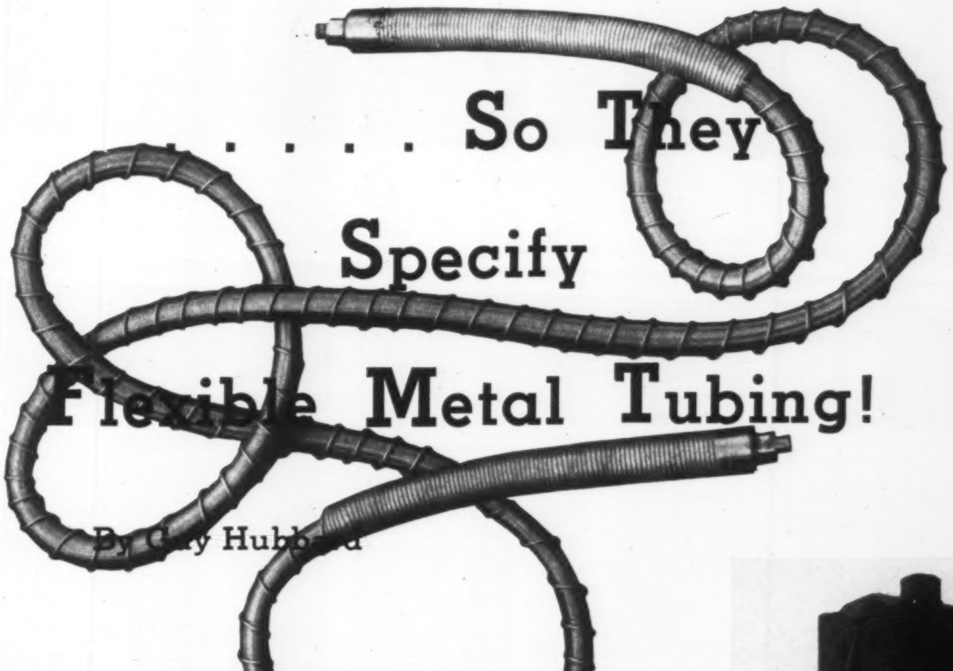


. . . . So They Specify Flexible Metal Tubing!

By Guy Hubbard

DESIGNERS in many fields—ranging as one might say from the smallest pressing machines to the largest locomotives—find themselves faced with an ever increasing number of cases where provision must be made to convey compressed air, steam, hot or cold water, oil, coolant and other gases and liquids under pressure, from the fixed to the moving elements. One reason for all this is the growing popularity of hydraulic and of pneumatic control systems. Another is the more general adoption of centralized pressure lubrication. Still another may be the broadening applications of liquid fuels. Many other reasons might likewise be mentioned. For instance, the rapidly increasing number of process machines.

Not so many years ago such problems were dealt with by means of leather hose; or plain, fabric covered or wire-wound rubber tubing; or with articulated metal piping. Of late years rapid strides have been made in the development of various types of flexible metal hose and tubing and in the methods of its quantity production. As a result, this material is now thoroughly dependable and very reasonable in cost, and has become available in a wide range of standard sizes and in qualities which successfully withstand high heats and high pressures, as well as corrosive conditions. It is

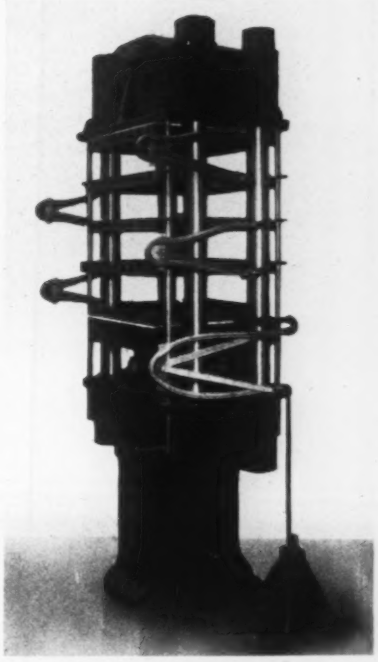
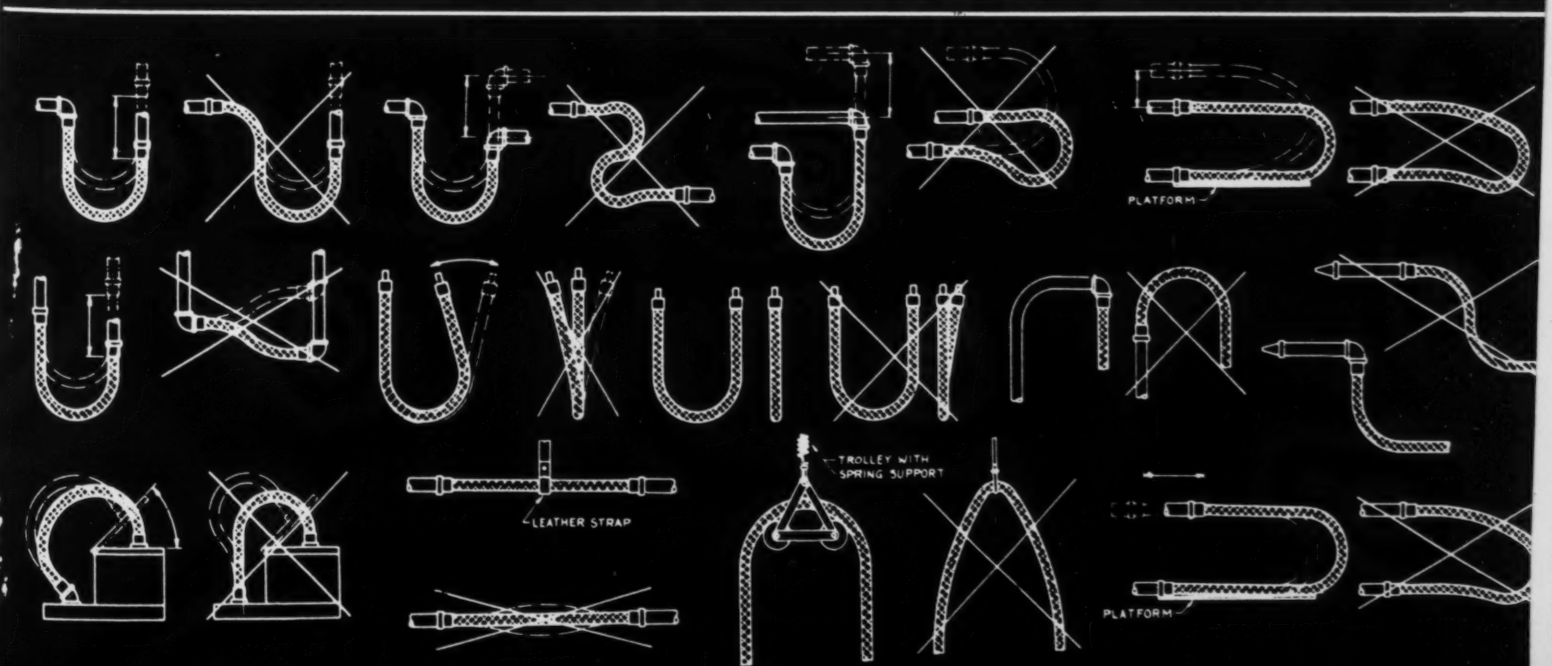
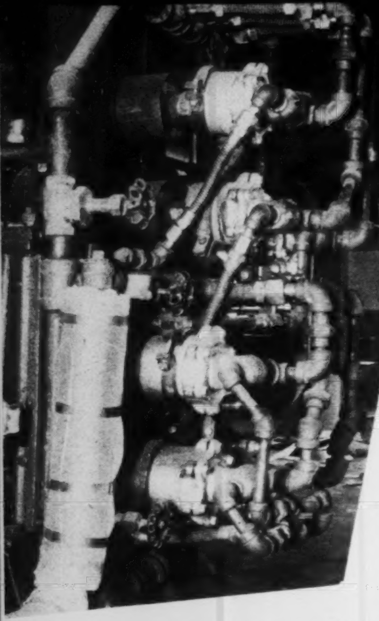
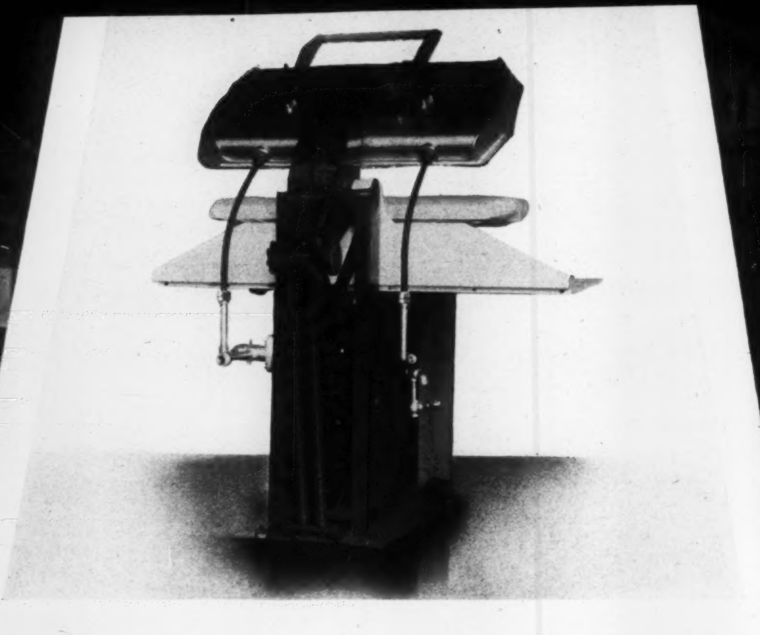


Fig. 1—Flexible metal tubes with pantograph supports convey steam to platens of hydraulic molding press

Fig. 2—Below—Good and bad practice with flexible metal tubing—crosses indicating bad installations







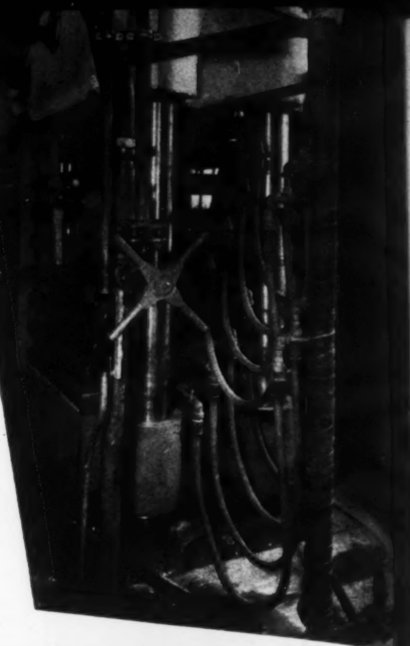
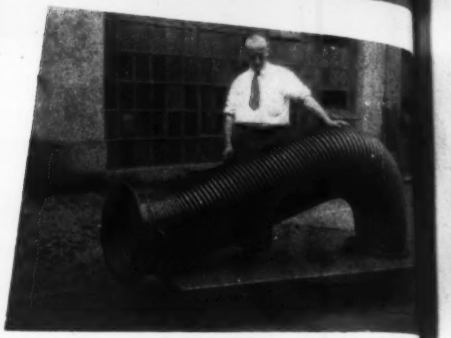


Fig. 3—Left, above—Flexible steam connections to rolls of corrugated paper box machine

Fig. 6—Center—Use of flexible metal tubing as steam lines to moving head of a pressing machine

Fig. 7—Right, above—Monel flexible tubing to platens of steam heated molding press

Fig. 8—Right—Example of large diameter flexible metal tubing for power plant use



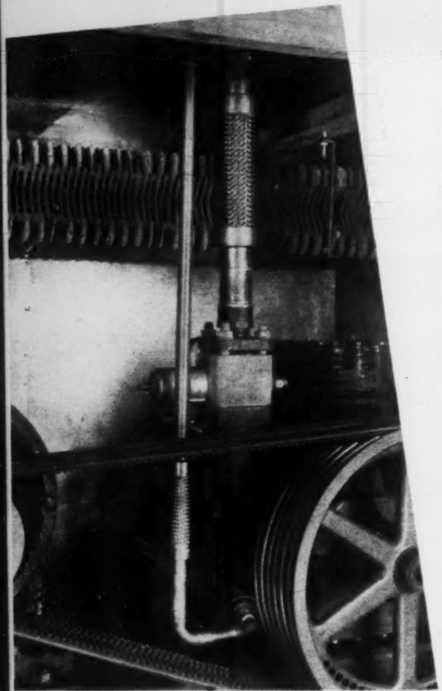
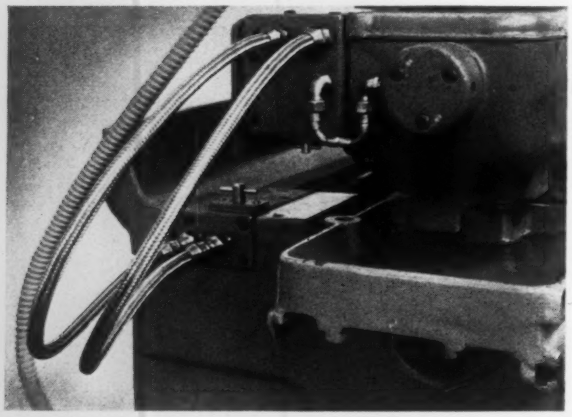


Fig. 4—Above—Use of flexible metal elements as vibration absorbers and sound insulators in compressor lines

Fig. 5—Below—Oil leads on grinder are flexible metal sheathed in cellulose, synthetic rubber and metallic braid



simple and cheap to install, it allows great freedom and wide range of movement of the elements to which it is connected, and it looks well on a machine.

The engineers responsible for the design of the various mechanisms illustrated in connection with this article are alive to the significance of the developments mentioned in the foregoing paragraph—and so they specify flexible metal tubing selected to suit their particular needs. The possibilities of flexible metal hose and tubing as now commercially available really are almost endless. While this article can only touch upon a few of them, it is hoped that it may serve to inspire some of its readers to discover for themselves worthwhile applications in machines in the development of which they are vitally interested.

When it comes to the actual selection of the tubing it will be highly desirable—if not positively necessary—that advantage be taken of the applications engineering services of manufacturers of the material. This should be done early in the development of the design so that definite specifications can be put on the drawing, so that correct coupling facilities can be provided, and so that provision can be made for the motions of the tubing in relation to the other parts of the machine, as in the case of *Fig.* 1 for instance.

The mere fact that the material is flexible is not to be taken as assurance that its flexibility can be abused. What can be done, and what should not be done with the material under a variety of circumstances is made clear by *Fig.* 2. As for the actual "geometry" of installations, the designer will do well to follow those suggestions rather carefully, especially where the flexing is rather continuous.

Choice of the type of tubing, whether spirally wound or convoluted, whether covered and how; how packed; of what material constructed, etc., will depend on the nature of the installation, the service demanded, material to be conducted, pressure, corrosive conditions and many other factors. For instance, some installations will require the almost complete flexibility as of a rubber tube, while others will require friction in the material to make it self-supporting when bent into position as for instance to direct a stream of coolant in a machine tool.

The diverse conditions which flexible tubing and hose is called upon to meet is particularly well brought out by the group of photographs on Page 44. For instance, *Fig.* 3 shows one side of a section of a corrugated paper box machine, in which the steam-heated rolls have some degree of "float" up and down. To conduct the steam to the rolls short sections of flexible metal steam hose are used, allowing "float."

Vibration and Noise Are Eliminated

In *Fig.* 4, two sections of annular type, braid covered metal tubing eliminate vibration and control noise impulses set up by a compressor in its lines. Such use as a "vibration absorber" is assuming great importance in connection with air conditioning equipment, the noise and vibration of which might otherwise spread throughout the system.

The Heald grinder installation shown in *Fig.* 5 calls for constant flexing under oil pressure. The tubing in this case consists of a flexible metal core, surrounded by laminated cellulose, which in turn is surrounded by a synthetic rubber and metal braid.

The Troy foot-operated pressing machine, *Fig.* 6, utilizes flexible metal tubing to connect the steam manifold to the swinging head. This type of connection has met with approval because it does not require repacking and takes up very little room in the pressing department where machines are close.

The set-up depicted by *Fig.* 7 is an installation of Monel metal flexible hose as the steam feed lines of a platen press. This hose is of ½-inch inside diameter and is armored on the outside. It handles steam at 350 pounds per square inch, at 650 degrees Fahr.

While the material generally is thought of in terms of the smaller sizes, it actually is being produced up to as much as 40-inches inside diameter. *Fig.* 8 is an example of one of the recently developed large diameter sections of a type useful in power plant work.

In the field of aircraft the usefulness of flexible metal hose and tubing extends to vibration damping and noise reduction, as well as to places where relative motion must be allowed for. A striking example of generous use of the material is given in *Fig.* 9, which reveals full installations for fuel and oil lines.

Another case where the material is used in generous amounts is that shown by *Fig.* 10 which shows the dual connections to the moving head of a Barnes multiple drilling machine. In this case the heavy duty, hydraulic hose of 1-inch inside diameter is assembled with a high pressure swivel joint and carries pressure ranging from 800 to 1000-pounds per inch.

Machine Design is indebted to many individuals and companies for material embodied in this article. Among the latter are: American Metal Hose Branch, American Brass Co. (*Figs.* 1 and 6); Chicago Metal Hose Corp. (*Figs.* 4 and 5); Eclipse Aviation Corp. and International Nickel Co. Inc. (*Figs.* 7 and 8); Flex-O-Tube Co. (*Fig.* 10); Packless Metal Products Corp. (*Figs.* 2 and 3); Seamlex Co. Inc. (Illustration in the heading, which is of a 25-foot flexible bronze tube for conveying steam to heat water seal of gas holder); and TiteFlex Metal Hose Co. (*Fig.* 9).

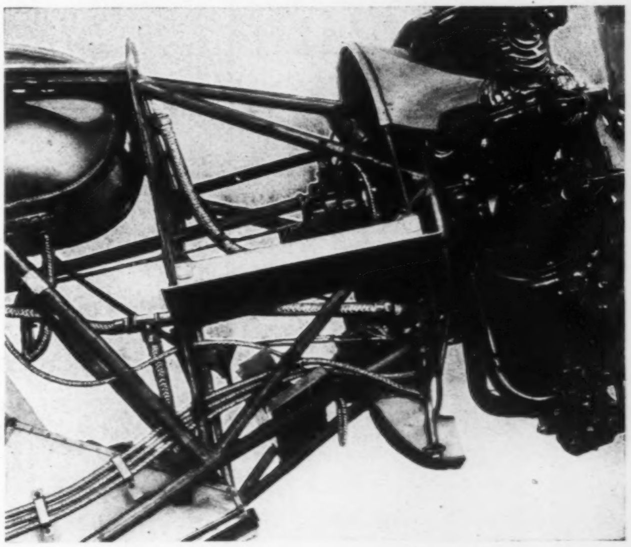
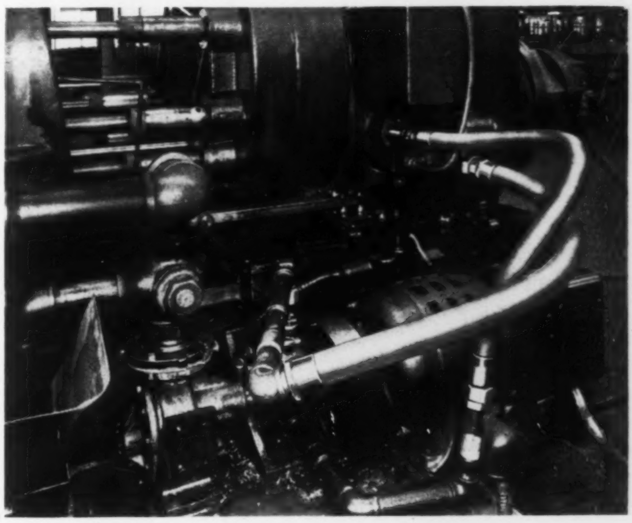


Fig. 9—Above—Airplane fusilage showing flexible metal fuel and oil lines connecting tanks with engine

Fig. 10—Below—Flexible metal hose in conjunction with swivel coupling conveys hydraulic power to drilling head



Speeding Ahead With Electricity!

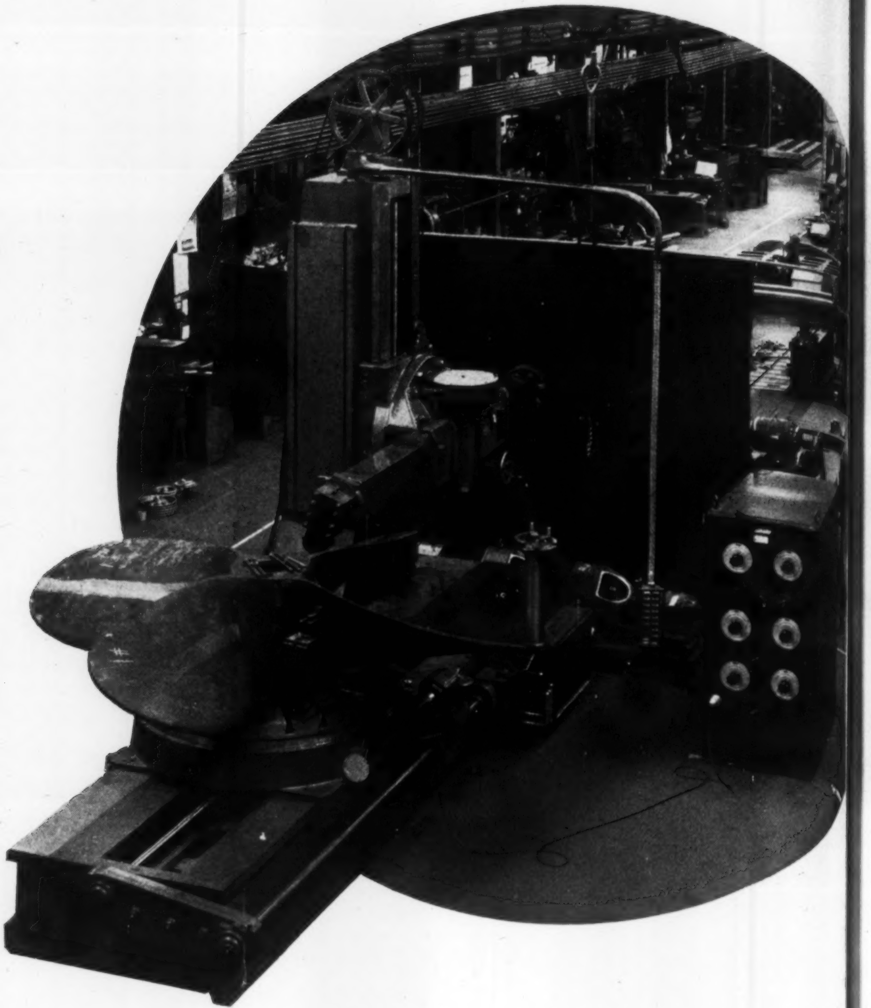
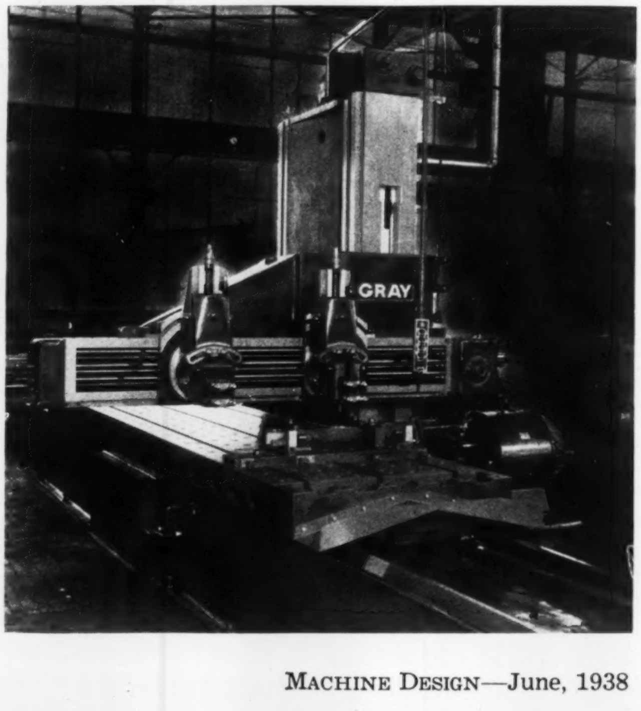


Fig. 1—Above—Electrified shaping-planing-milling machine which in effect can "cut a screw thread of 20-foot pitch with outside diameter of 15 feet and root diameter of 3 feet"

Fig. 2 — Below — Modern openside planer equipped with improved variable voltage drive, which increases percentage of actual cutting time and gives extreme range of speed



THAT the line of demarkation between mechanical and electrical engineering is fading as far as the machinery building industry is concerned, is a conclusion to be drawn from the proceedings which marked the third annual Machine Tool Electrification Forum held recently at the Westinghouse works at East Pittsburgh. To those who have watched the course of events it is plainly evident that through the co-operative efforts of mechanical and electrical engineers, along the lines defined in the paper delivered by R. S. Kersh, machinery is rapidly improving electrically. By the same token its electrical drive and control equipment is rapidly becoming much better mechanically.

A definite example of this last-mentioned trend was given at the first session when T. R. Lawson presented to a large audience of machine tool engineers and executives a "pre-view" of the program for standardization of shell-type motors. This program, which is a development from demands voiced during previous Forums, is now well on the way toward official action.

Typical of what can be accomplished by mechanical and electrical engineers working together, is the development covered in a paper by H. Earl Morton, president, Morton Mfg. Co., and Oren G. Rutemiller. "Consider," said Mr. Morton, "our problem of cutting a screw thread of 20-foot pitch on an outside diameter of 15 feet and root diameter of 3 feet!" The special machine which accomplishes this feat is shown in action by *Fig.* 1. The following are a few facts about it abstracted from the paper.

Machining of ship propeller blades is performed for the most part by "draw-cut" shaping. However, this machine also is capable of milling, rotary planing and "push-cut" shaping. Blades of constant pitch propellers are machined by draw-cut shaping radially outward from the hub, it being necessary to cut a relief at the hub to allow the shaping tool to enter. This is cut either by rotary planing or milling. Fillets at hub ends of blades are machined with an end mill.

Minimum incremental shaping feed desirable is 1/32-inch at the 15-foot diameter. This means minimum feed of 1/160-inch at the 3-foot diameter—too small to be practical. Minimum desirable incremental feed at the 3-foot diameter is 3/16-inch, which means maximum feed of 15/16-inch at the 15-foot diameter. In other words, it was necessary to cover a range of incremental feeds from 1/32 to 15/16-inch on the 15-foot diameter.

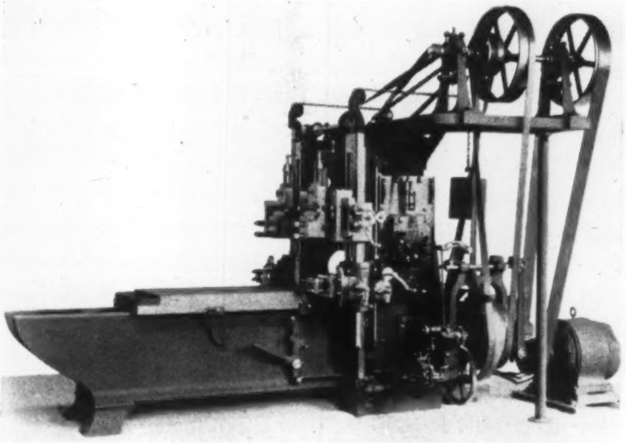


Fig. 3—Early example of motorized planer, one of the initial steps toward the refined designs of today

This is accomplished by an adjustable measuring relay feed drive. This controls the motor so that it will make a certain definite, measured number of revolutions each time a feed occurs and reset electrically.

Since short as well as long stroke planing must be accomplished, time for feeding usually is short. The variable voltage planer drive actually reciprocates the ram at forty, 6-inch strokes per minute.

It has been found possible to control the feed motor to 1/12 of a revolution, so on the basis of forty cutting strokes per minute, less than one second is available for feeding. As fifteen motor revolutions are too many for that space of time, one gear change is employed in the feed drive to allow large feeds in a few motor revolutions.

For set-up purposes fast traverse of 60-feet per minute at the 15-foot diameter is provided, while for "inching" 0.6-feet per minute is possible on the same diameter. Feed speeds for milling fillets range from 2 to 12-inches per minute at the 3-foot diameter. For rotary planing the feed drive operates as a reciprocating drive, giving cutting speeds from 15 to 45-feet per minute, and return speeds from 45 to 60-feet per minute, at the 15-foot diameter.

The improved variable voltage drive was selected to deliver 10 horsepower at 700 revolutions per minute, with total speed range from 12 to 1200. Specifications call for constant torque from 12 to 700-revolutions per minute and constant horsepower from 700 to 1200. Ram drive is designed to give fast traverse of 40-feet per minute and inching speed of 1.5. Cutting speeds range from 12 to 85-feet per minute and return speeds 85 to 120. Ram drive motor is rated at 10 horsepower at 500-revolutions per minute. It is of planer-type, its small diameter armature favoring rapid reversal.

Control equipment is a floor-mounted cabinet with operator's station, containing all rheostat and set-up switches, built into its left end. One of the switches selects "push" or "pull" cut. A pendant station carries an emergency stop lever and two rows of seven push-buttons each, the left controlling the ram motor, the right the feed motor.

This machine demonstrates the possibilities of wide-speed range, variable voltage drive as applied to feed and traverse motions. With ordinary direct current motors, even of 6 to 1 maximum speed range, a great number of speed change gears would be required.

Discusses Planer Drives and Controls

In his paper on planer drives, John E. Doran, an executive of the G. A. Gray Co. who has invented and patented notable improvements in planers, presented an interesting outline of planer history bearing particularly on development of electrical drive and control.

The first circular covering motor driven planers built by Mr. Doran's company was issued in 1893. The smallest of these machines, designed for work up to 22 inches square and of any desired length, was equipped with a 2½ horsepower main motor—less power than that of the cross rail motor on a modern machine of comparable size. The heaviest machines, such as frog and switch planers, had 18-horsepower motors. Such machines today take 50 to 75 horse power.

As power and speed increased, the use of shifting belts for reversing, as in *Fig.* 3, became more and more of a problem, their speed tending to destroy their tractive effect on their pulleys. At the same time and up to as late as 1904, the use of reversing motors on planers was impractical because there were few generating plants with sufficient capacity to supply such motors without creating serious difficulties for other motors and also in their electric lighting circuits. That situation cleared up however between that time and 1912 when the G. A. Gray Co. installed in its own plant a planer with reversing motor drive.

The original commercial planer reversing motor was of 4/1 range and it was ten years before anybody thought of either a wider or a lower range.

During the past ten years electrical manufacturers have developed the 6 to 1, 250/1500; the 150/600; and the 150/900 revolutions per minute planer motors; the 100/1200 constant voltage type; and last and foremost the 40/1200 revolutions per minute, 30 to 1 improved variable voltage planer equipment. A front view of a modern, heavy-duty openside planer equipped with the improved variable voltage drive, is presented as *Fig.* 2. One of the most effective ways to judge the degree of progress represented by this machine is to compare its drive and the control with that of one of the early types of individual motor drives shown by *Fig.* 3.

The slower speed planer motors were developed to meet the need for quick-acting, adjustable speed motors to increase the percentage of time the tools actually are cutting metal, which of course increases the efficiency and productivity of the machines into which they are incorporated. The improved variable voltage drive was developed to secure—in addition to the foregoing—a sufficiently wide speed range to permit of economical use of cemented carbide tools at the one extreme, and at the other extreme to provide the very low speeds suitable for machining chilled cast iron and hard, tough alloys.

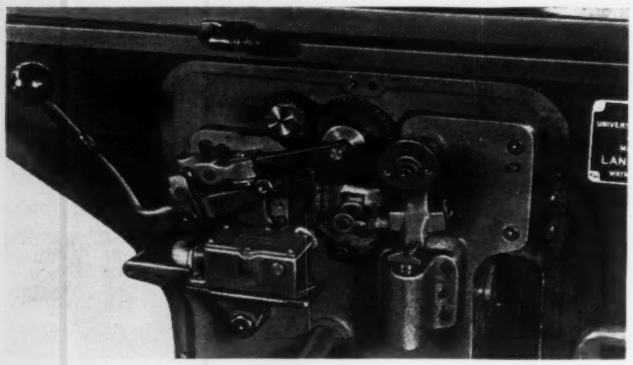
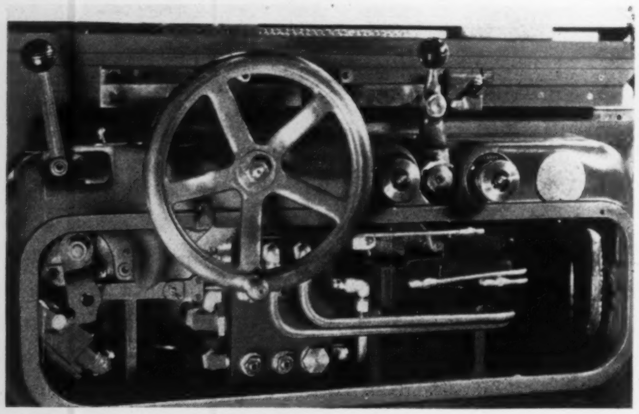


Fig. 4—Above—Electrical control actually "designed in" as part of a universal and tool grinder

Fig. 5—Below—Electrified grinder control, featuring (left) a special adaptation of the limit switch



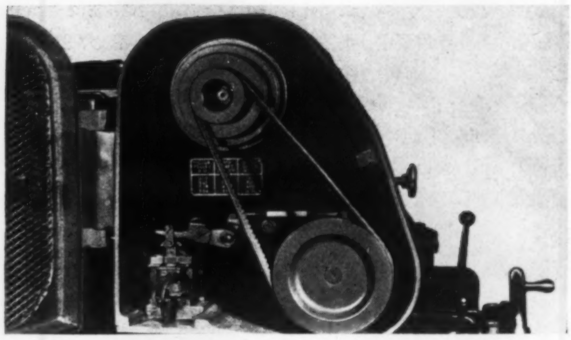


Fig. 6—Method by which brake in the drive of grinder is actuated by a powerful, compact solenoid

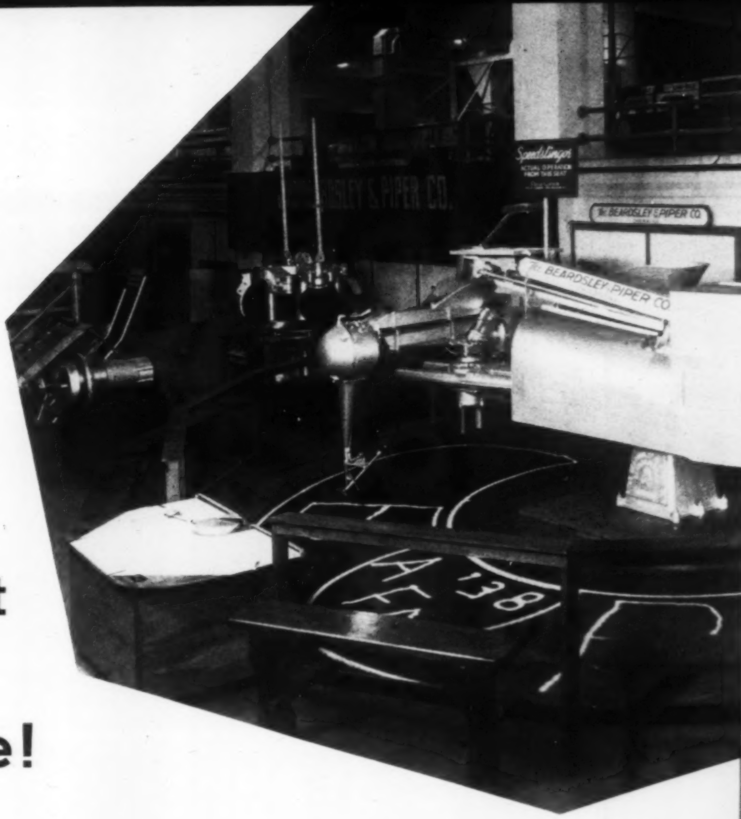
On the basis of his many years of experience in the electrification of industrial machinery, R. S. Elberty, electrical engineer of the Landis Tool Co., presented a paper of which the major theme was, "Build electric control as an integral part of the machine." It will be recalled by many that Mr. Elberty was a founder of the Forum and has since been very active in its promotion.

Mr. Elberty pointed out that modern manufacturing methods require that machining methods be as flexible as possible. The removal of a machine from one department and setting it to work in another department—all within an hour's time—happens so frequently that design must provide for it. The machine must be completely self-contained, including its hydraulic and electric drive, coolant system, etc. Electrical control today is one of the most important factors in making possible the really self-contained machine tool with automatic operating features.

Electrical manufacturers have not offered as complete a line of control accessories as has been required and therefore many machinery builders are making certain control accessories—either completely or by modifying standard apparatus. There are so many machine tool builders that the sum total of these special developments undoubtedly run to quite a figure.

Examples of built-in electrical control devices are shown herewith as *Figs.* 4, 5 and 6. The first shows the main control station of a universal and tool grinder, with the cover removed. The second shows—at the left—an interesting limit switch application. The third is a solenoid-operated brake on the drive mechanism.

Machine tools should be electrified while still "on the drawing board." Many objectionable features of electrified tools have been due to the fact that the last and least consideration in the design was given to the electrical equipment. Forethought in the application of electrical equipment—including its wiring—while the machine still is in the design state will pay big dividends in reduced cost, better performance and improved appearance.



Foundry Equipment On Parade!

THAT the foundry industry today is making use of every possible mechanical aid, and that active progress in this industry is due in no small degree to its mechanization, are conclusions to be drawn from the national convention and exposition of the American Foundrymen's association. Not since the last Machine Tool exposition has such a large and interesting showing of basic industrial equipment been held, and not since that time has there been a more convincing demonstration of the active role that machine designers are playing in making possible better metal products at lower cost, produced under comfortable working conditions.

Study of this exposition convinces the observer that in any foundry, even a small one, rule-of-thumb methods are now definitely "out." Given the engineering and metallurgical specificatio
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Fig. 1—At top of page—Functioning as a pantograph, electrically operated sandslinger draws diagrams on floor to demonstrate precision of control

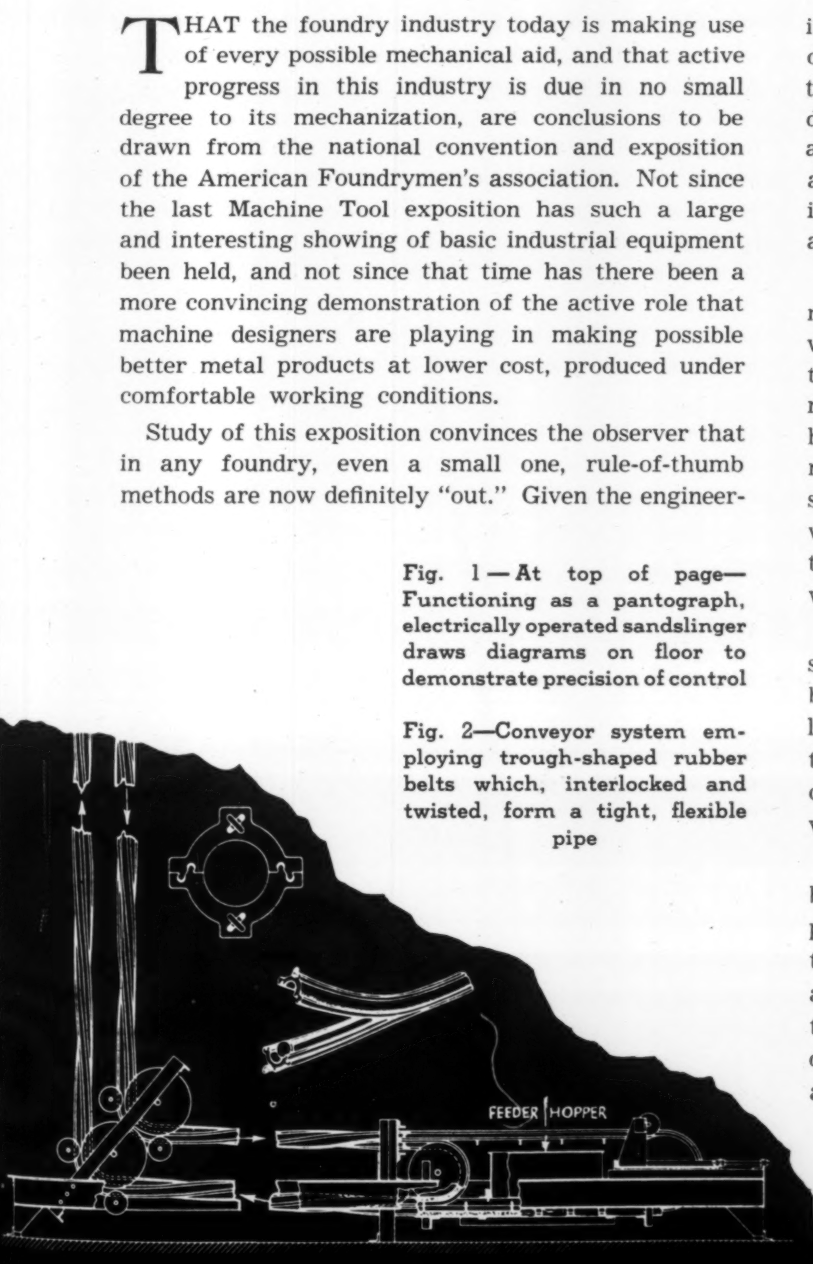

Fig. 2—Conveyor system employing trough-shaped rubber belts which, interlocked and twisted, form a tight, flexible pipe

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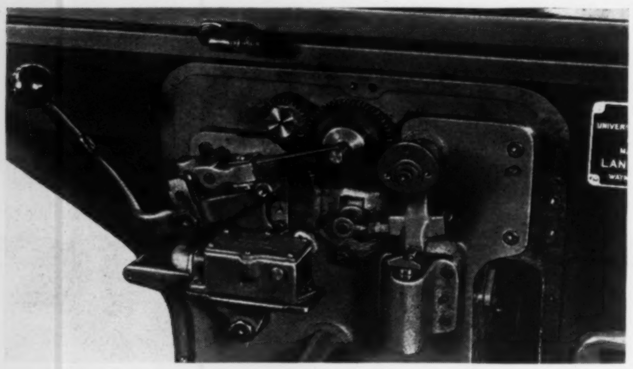

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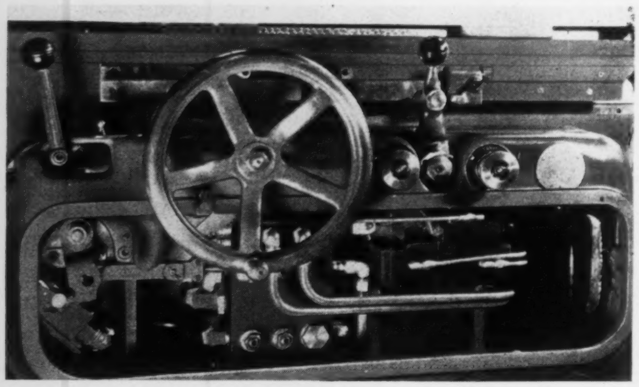

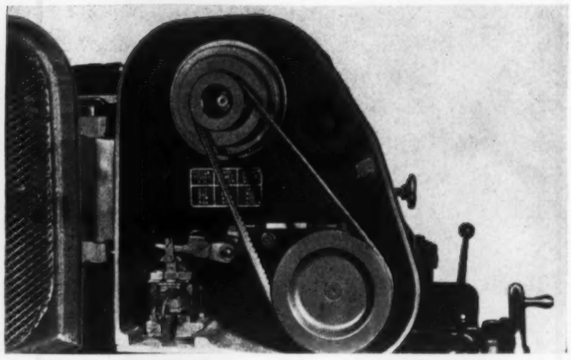

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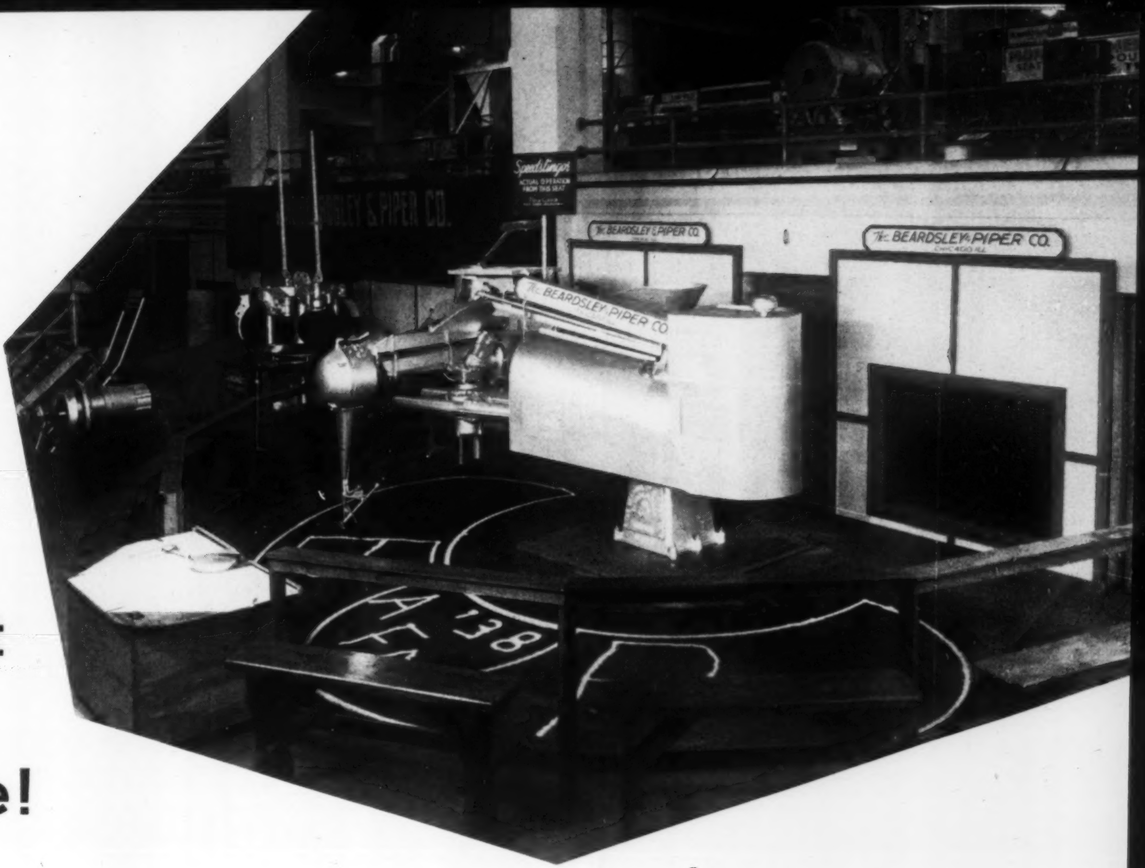
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Fig. 1—At top of page—Functioning as a pantograph, electrically operated sandslinger draws diagrams on floor to demonstrate precision of control

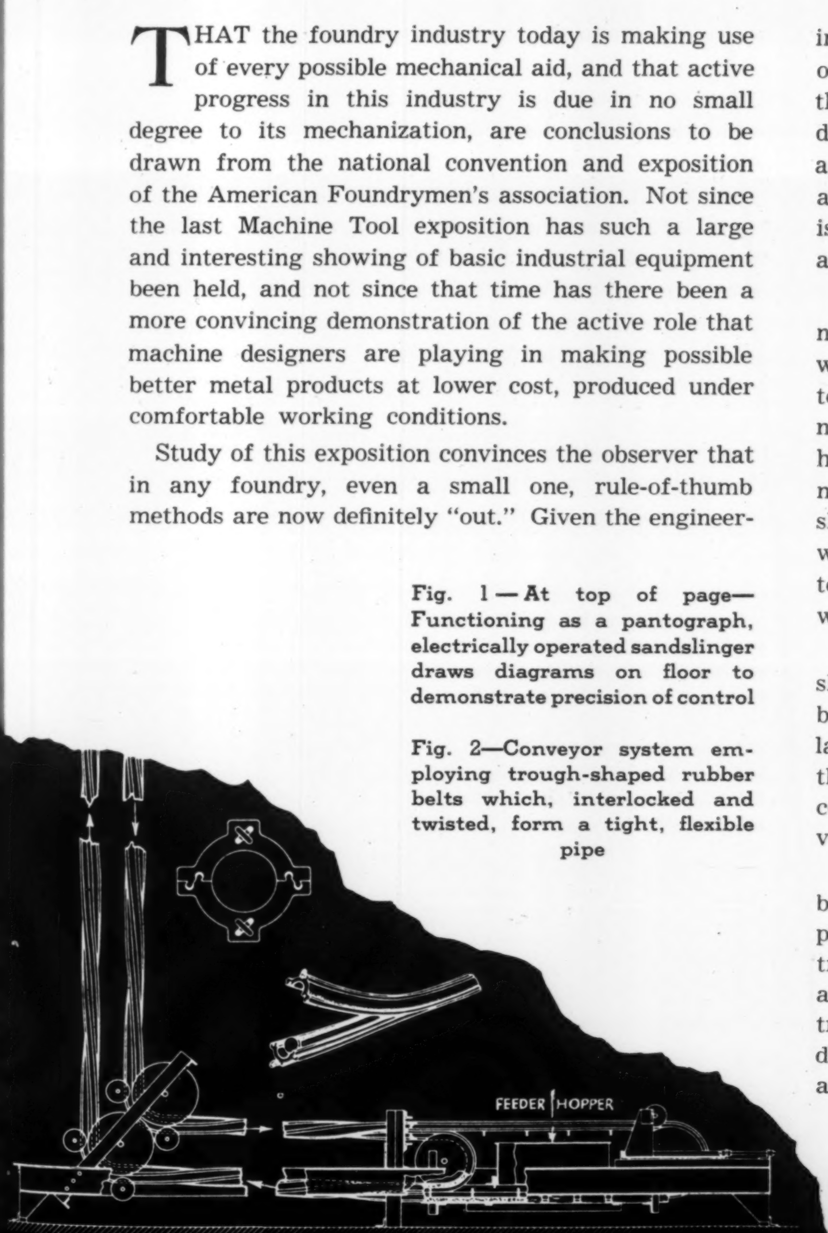
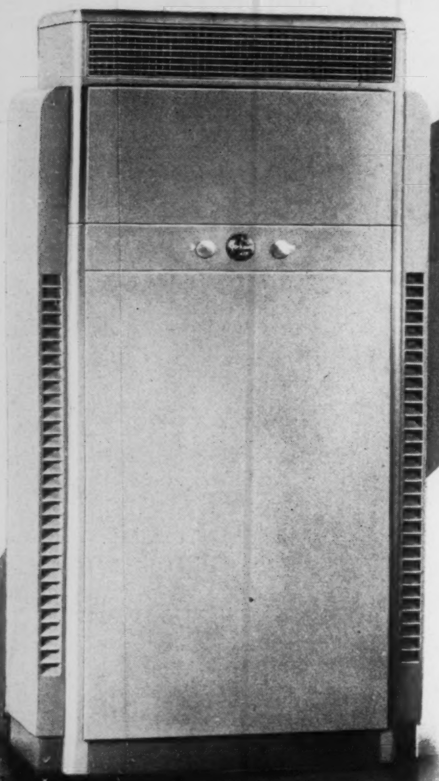


Fig. 2—Conveyor system employing trough-shaped rubber belts which, interlocked and twisted, form a tight, flexible pipe

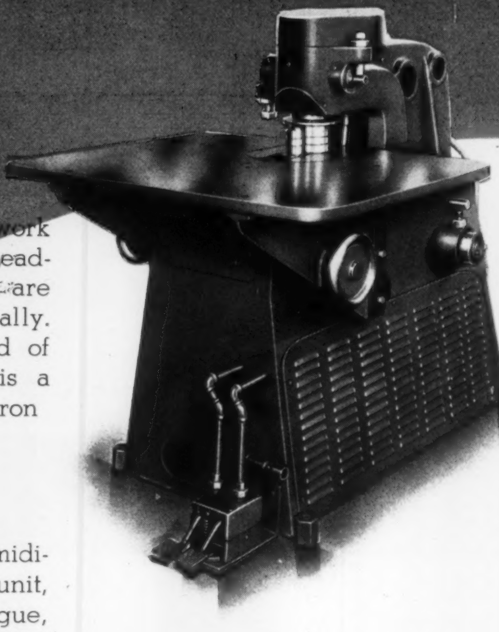
Many factors enter into the making of good castings, not the least of which is the traditional skill of foundry workmen. Such workmen deserve the best materials, tools and working conditions. To a large degree the new and improved mechanical equipment on exhibition has been designed to relieve these men of tasks which no human being should be called upon to do; to spread skill over an amount of work for which there never will be enough skilled men working manually; and to prevent or remove the smoke, fumes and dust in which men cannot be expected to work at their best.

Typical of machines for spreading and multiplying skill is the electrically-controlled sandslinger depicted by *Fig.* 1, the precise, quick control of which over a large area was demonstrated by remote control through a pantograph arrangement. Ordinarily, of course, the operator rides this machine—his seat being visible in the illustration.

Typical of equipment for relieving men of back-breaking labor is the unique conveyor for sand, depicted diagrammatically by *Fig.* 2. This embodies trough-shaped rubber belts which, when interlocked and twisted as shown, form a dust and watertight traveling flexible tube which picks up, conveys and discharges material silently and efficiently, and at a high rate of speed.



Revolving rolls on the Quickwork machine, right, for trimming, beading and forming of stampings are opened and closed pneumatically. Base of machine is constructed of welded steel; upper housing is a heavy casting of high-grade iron



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For cooling, filtering and dehumidifying, the York air conditioning unit, left, styled by Walter Dorwin Teague, is available. Compressor and fan with their motors are spring mounted to absorb vibration and reduce noise. Side ducts extend almost to floor to receive return air from as low a point in room as possible

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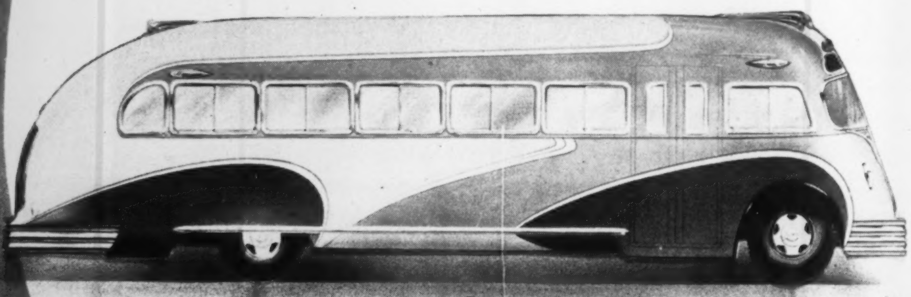
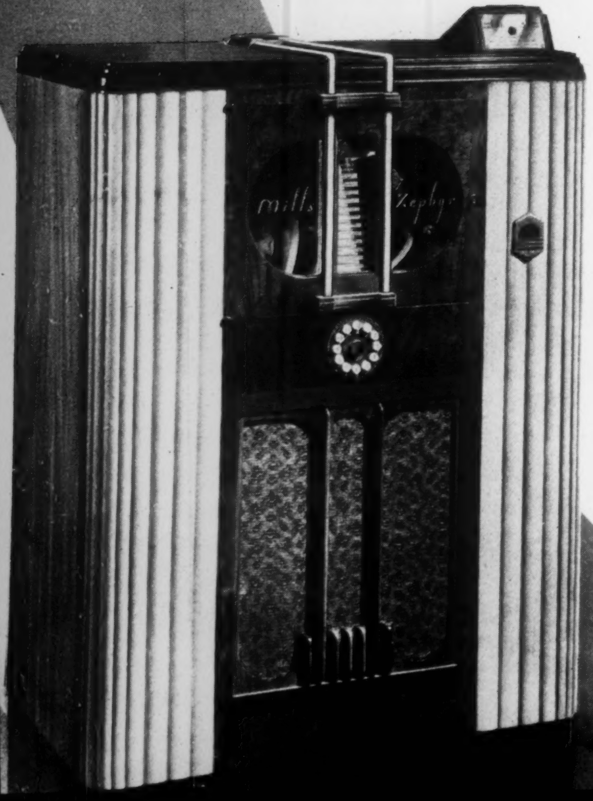
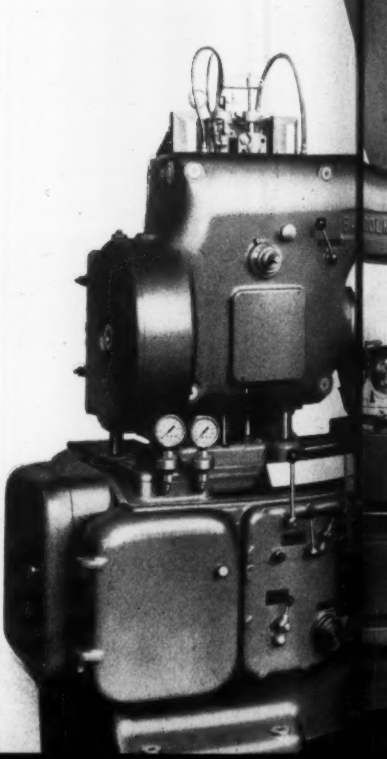


Rear engine mounting, acetylene welded integral frame and body, and streamline finish make the model D Gar Wood coach, above, the ultramodern in bus transportation. Passenger compartment is completely insulated against heat and cold; mounting of engine in rear reduces noise and excludes fumes



Entire audio system of the Mills Zephyr automatic phonograph, left, is accurately matched to the particular characteristics and resonance of the cabinets to give superior tone performance. Machine is brilliantly illuminated by two Lucite bars running down front of cabinet and radiating ever-changing colors



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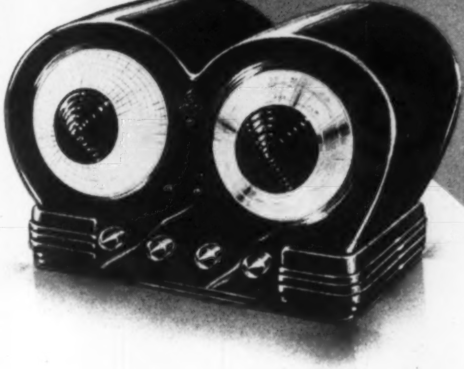
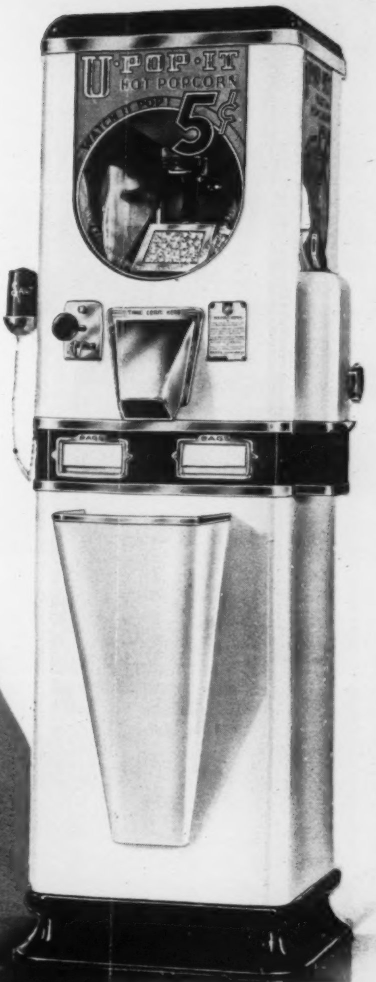
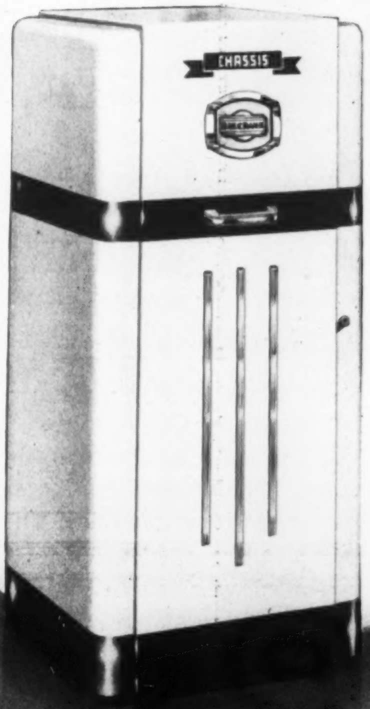
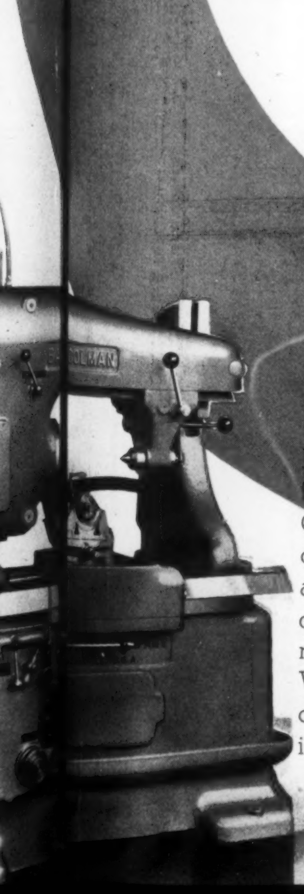


Styled by Barnes & Reinecke, the Ranel coin-operated corn popping machine, right, utilizes a gray iron casting for the base and castings of aluminum for internal parts. Electric heat for popping corn is controlled by bimetal thermostat. Finish is baked enamel



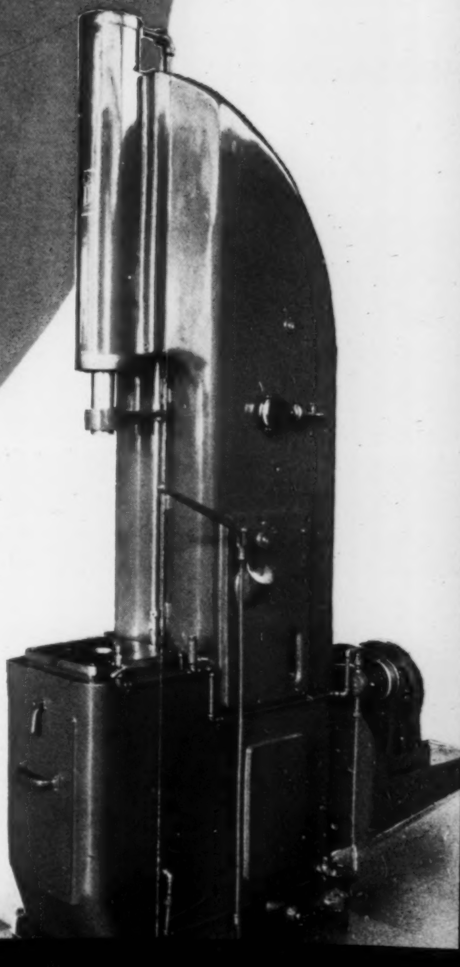
Enamel finish and chromium trim of the Balcrank "lube-liner", left, make this garage accessory a thing of beauty. Hose of synthetic rubber is resistant to grease and is completely concealed when out of use. Pump will handle viscous or fluid lubricant





Indexing, feeding, and clamping of work on the Barber-Colman type "D" hobbing machine, left, are hydraulically actuated, allowing a multitude of feed speeds without the necessity of gear changes. Work slide and overarm are cast integrally and the assembly is supported on the upright in double V ways

By designing work table integral with vertical column in the hydraulic press made by the American Broach & Machine Co., right, exceptionally solid construction is obtained. Leather cup is placed on top of hydraulic piston, spreading when pressure is applied and giving leakproof fit



Designers Should Be Unrestricted in Study of Operating Conditions

A SLOGAN such as "Give the customer what he wants" is excellent—with provisos! There's that little matter of whether he can pay for the machine to be considered, as well as the question of whether a sufficient number of other people might want it to warrant its being produced as a standard line under mass production.

Numerous instances could be cited of organizations believing they knew what was wanted and going ahead with production—only to find they were too far ahead of the thinking of the majority of potential customers and consequently being compelled to withdraw the line. Errors of judgment of this kind usually can be accounted for by factors such as inflexible one-man control, lack of sufficient customer research, or ultra-conservatism on the part of purchasers.

There seems to be only one systematic way to avoid this type of financial loss and damage to prestige: Let research of the market bring to the engineer responsible for design, sufficient data on which to base the development of the machine. The engineer himself should be urged to go into the field to assist those making the survey. Too often the designer is kept in the dark and lacks the initiative or the chance to go out and check at first hand the conditions he is designing to meet.

Field information, brought in or sent in from unbiased and authoritative sources, has enabled thousands of companies to do the "right thing at the right time." It facilitates the development of the machine to a point where a batch of ten or twenty can be built for actual field test—and, as has been proved conclusively, such tests can yield far different and more extensive results than any obtained in the plant of the machinery builder! The best proving ground is, after all, the location in which the machine is to be installed; the best "provers" the operators, often unskilled, who eventually will be charged with the responsibility for handling and taking care of the machine.

An illuminating instance of utilization of research is portrayed by the design of the home laundry unit discussed in the first article in this issue. Field research in this instance indicated one thing above all else—the necessity for automaticity in operation. How well the engineers who developed the machine took advantage of advance knowledge is clearly evident—and how different the completed design might have been if they had not had it can only too well be imagined in the light of predecessors in the washing machine field.

Men of Machines

D. E. Batesole

RECENT appointment of D. E. Batesole as chief engineer of Norma-Hoffmann Bearings Corp., Stamford, Conn., has been announced. Since 1925, until his present appointment, Mr. Batesole has been assistant chief engineer of the company.

After serving a three-year apprenticeship in a machine shop he attended Ohio State university, graduating with a mechanical engineering degree in 1916. He then joined the engineering department of Willys-Overland Co., engaging in engine design. A year later he accepted a position with Norma-Hoffmann Bearings Corp. as sales engineer, remaining there only a few months before enlistment in the Signal Corps and later, the Engineering Corps. In 1919 he returned to the Norma-Hoffmann company as sales and service engineer, retaining this position until becoming assistant chief engineer.

• • •

AS CHIEF engineer of the Brunner Mfg. Co., in charge of the engineering department covering design and specification, S. Robert Hirsch will put to good use his broad technical experience and sound knowledge of refrigeration and air conditioning engineering. He was formerly assistant chief engineer of the Carbondale division of Worthington Pump & Machinery Corp.

Prior to graduating from Cornell in mechanical engineering Mr. Hirsch served as radio operator on board ship. After graduation he joined Worthington where among his other duties he spent a number of years on research problems and air compressor engineering. A promotion then placed him in an engineering executive position, and later when Worthington acquired the Carbondale division he was made assistant chief engineer specializing in design and application of the company's equipment.

S. Robert Hirsch

• • •

Howard J. Tyzzer

A PIONEER in the radio field, starting as an amateur in 1911, and an inventor, having been granted several patents in this industry, Howard J. Tyzzer now reaches a "new high" in his appointment as chief engineer of the household radio division of the well-known Crosley Radio Corp.

His practical experience began in 1916 when he entered the employ of American Radio and Research Corp., as laboratory assistant. In 1921 when the company changed its name to that of the Amrad Corp., he became chief radio engineer and served in that capacity for three years. He then joined King Hinners Radio Corp. as chief engineer, and for the next two years was chief engineer of the Power Radio Corp. In 1928 he returned to the Amrad Corp. as production engineer, and remained until the company was dissolved when he went with the Magnavox Co., Fort Wayne, Ind. During the following two years, he served as chief engineer of the Pilot Radio & Tube Corp., Lawrence, Mass., and Long Island City, N. Y.

In 1933 Mr. Tyzzer joined Crosley and since that time has served in various capacities, including that of chief engineer of the Kokomo division.

◆ ◆ ◆

William A. Purtell, president of Holo Krome Screw Corp., and president-treasurer of Billings & Spencer Co., was elected president of the American Supply & Machinery Manufacturers' association, a national body composed of manufacturers of industrial supplies and machinery.

◆ ◆ ◆

Bruce Hayter, who for the last four years has been chief engineer of the Institute of Thermal Research, has resigned his position with American Radiator Co. to become chief engineer of Oil Devices Inc., Columbus, O.

◆ ◆ ◆

H. T. Heald has been elected president of Armour Institute of Technology. He has been with the institute since 1927, serving as assistant professor, associate professor, assistant dean of the school, and since 1934 as full professor and dean. Since the resignation of Dr. Willard E. Hotchkiss last October Mr. Heald had been acting president.

◆ ◆ ◆

Stephen J. Benn has become a member of the engineering staff of Brunner Mfg. Co., in the capacity of assistant chief engineer. For thirteen years prior to joining the Brunner company, Mr. Benn had been with Merchant & Evans Co., eight years of which he was chief engineer in charge of experimental work and new designs, and also refrigeration applications in general.

◆ ◆ ◆

E. F. Carter, since 1932 a member of the Hygrade Sylvania Corp. engineering department, has been appointed assistant chief engineer to R. M. Wise, chief engineer, co-ordinating the tube engineering activities of the Salem and Emporium plants.

◆ ◆ ◆

Charles R. Hook has been elected president of the National Association of Manufacturers for 1938, succeeding William B. Warner who has been elected chairman of the association's board. Mr. Hook is president of American Rolling Mill Co., and Mr. Warner is president of McCall Corp.

◆ ◆ ◆

Walter H. Bruckner has been appointed metallurgical engineering research associate in the engineering experiment station of University of Illinois.

◆ ◆ ◆

W. R. Ferguson, formerly with Owens-Illinois Glass Co., A. J. Metzger, formerly with Charles Taylor Sons Co., and M. F. Tarnopol, of the Pennsylvania State college faculty, have been added to the technical staff of the ceramics division of Battelle Memorial institute.

◆ ◆ ◆

R. L. Baldwin, National Carbon Co. Inc., Niagara Falls, N. Y., has been elected president of the Electrochemical society.

◆ ◆ ◆

Frederick Ayres Lorenz Jr., vice president of American Steel Foundries, Chicago, has been awarded the Joseph F. Seaman gold medal by the American Foundrymen's association "for his leadership and accomplishments in the management and commercial phases of casting manufacture and his service to the foundry industry."

◆ ◆ ◆

Victor A. Hanson, vice president and chief engineer of the Power Transmission council, has been transferred from Boston to Detroit where he will make a study of power transmission problems in the automotive industry.

◆ ◆ ◆

Howard Dingle was recently elected president of the American Gear Manufacturers' association. For the past eleven years he has been president of the Cleveland Worm & Gear Co., Cleveland. A personal sketch of Mr. Dingle appeared in the August, 1937, issue of Machine Design. Charles F. Goedke, president of Ganschow Gear Co., Chicago, was named vice president of the AGMA.

◆ ◆ ◆

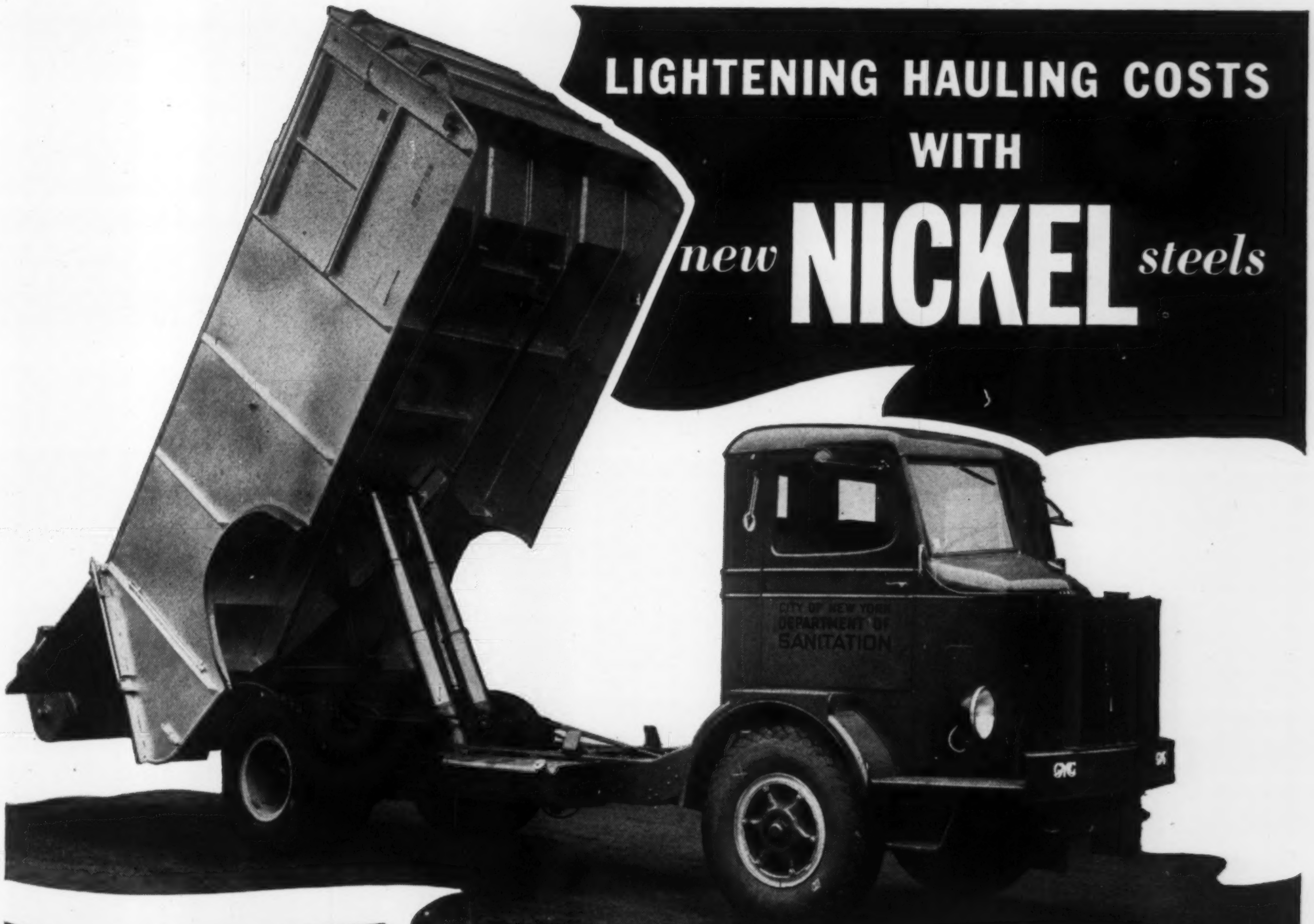
Andrew W. Soderberg, originator of the "rocking shear" principle for cutting wide steel plate (an article on which appeared in the August, 1937, issue of Machine Design under the title "An Engineer's Work is Never Done—He May Invent at Home"), has retired as chief engineer of the Homestead works of Carnegie-Illinois Steel Corp. Mr. Soderberg resigned on his seventieth birthday, after completing forty-nine years of service with the Carnegie-Illinois company and its predecessor.

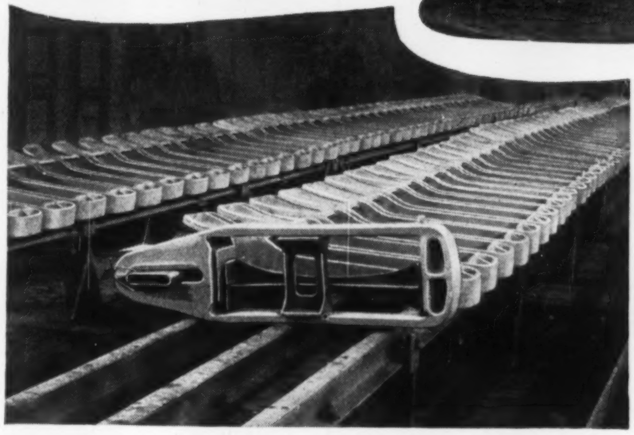
Obituaries

Forrest E. Cardullo, chief engineer of the G. A. Gray Co., Cincinnati, since 1919, died at the age of 59.

Graduating from Cornell in 1901 he was engaged in the design of heavy engines and steam pumping engines until 1905. For the next three years he was instructor and assistant professor of mechanical engineering subjects at Syracuse university, and from 1908 to 1914, professor of mechanical engineering at New Hampshire state college. He became chief draftsman of Pierce-Arrow Motor Car Co. the following year, and resigned to become engineer of tests with

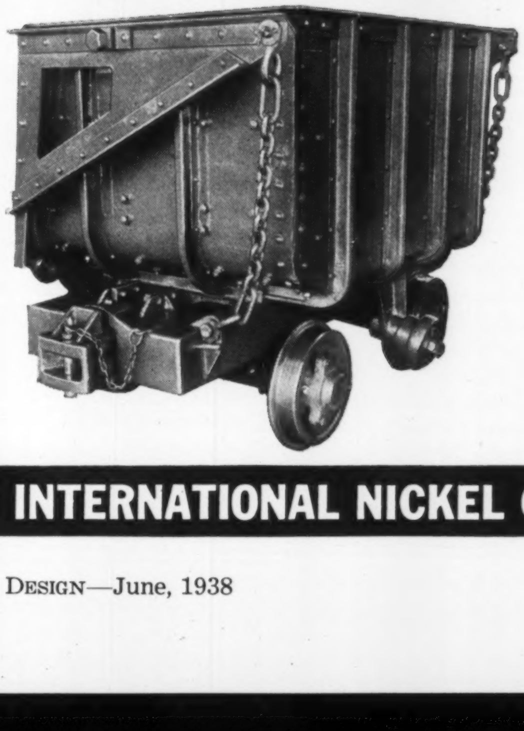
LIGHTENING HAULING COSTS WITH *new* NICKEL *steels*





..ON MANHATTAN STREETS—To save trucking tons of deadweight through congested traffic, the City of New York specified its new fleet of refuse trucks with lightweight, high-strength bodies of "Yoloy". These self-loading, self-dumping bodies were built by Gar Wood Industries on GMC chassis. Yoloy is a Nickel-copper steel which resists wear and corrosion. It is produced by the Youngstown Sheet & Tube Co.

..OVER MOUNTAIN GRADES—The progressive Union Pacific Railroad has learned that freight car castings can be lightened 20-25% by utilizing Nickel cast steels. These tough Nickel alloy steel bolsters were produced by the Buckeye Steel Castings Company for the Union Pacific's modern new freight cars.



.DEEP IN MINES—3,000 feet down in a Copper Cliff mine, rust and corrosion continuously attack metals. Hurried loading and dumping of ore-bearing rock causes severe abrasion. To cut handling costs, light-weight Granby-type mine cars of Nickel alloy steels were ordered from the Canadian Car & Foundry Company. This modern Nickel alloy steel equipment so markedly reduced operating and repair costs that 123 additional cars will soon be in use.

THE INTERNATIONAL NICKEL COMPANY, INC., NEW YORK, N.Y.

Curtiss Aeroplane & Motor Corp., remaining there until joining the G. A. Gray Co. in 1919.

Mr. Cardullo was the inventor of many important improvements in the machine tool field. One of the most noteworthy was a system of helical involute gearing for metal planers. He was a member of the American Society of Mechanical Engineers.

◆ ◆ ◆

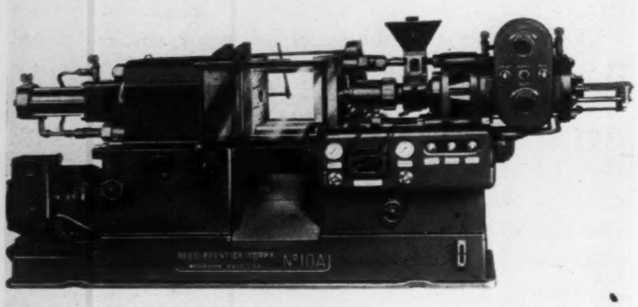
P. B. ROGERS, 41, died May 22 of bronchial pneumonia. He was eastern procurement representative for the Douglas Aircraft Corp., Santa Monica, Calif., and former vice president of Great Lakes Aircraft Corp. Mr. Rogers, widely known in aviation circles, started his career in Cleveland as a designer for the Glenn L. Martin Co. He became associated with the Great Lakes Aircraft Corp. as chief engineer, and later was made vice president. He joined the Douglas company in July, 1937.

◆ ◆ ◆

AXEL W. FORSBERG, 69, formerly chief engineer of Continental Tool Works, Detroit, died recently. He had retired three years ago.

Hydraulics Operate Plastic Molder

FEW better examples of hydraulic power application can be mentioned than its use on plastic molding machines. Quick, sure die movement with injection pressures on material from 2000 to 21,000 pounds per square inch are easily obtained. Inadvertently in the April issue of MACHINE DESIGN a Reed-Prentice molding machine was captioned as being pneumatically operated. This was in error and we take the opportunity to bring a new model injection molding machine to the attention of our readers in which hydraulic power again plays an important part. A 15-horsepower motor drives the hydraulic pump for opening and closing die plates and moving the injection plunger at 120 inches per minute. Machine is completely automatic and timing controls with dials have been improved with larger capacity rotors in the timers for quicker operation. The machine is known as the model 10A.

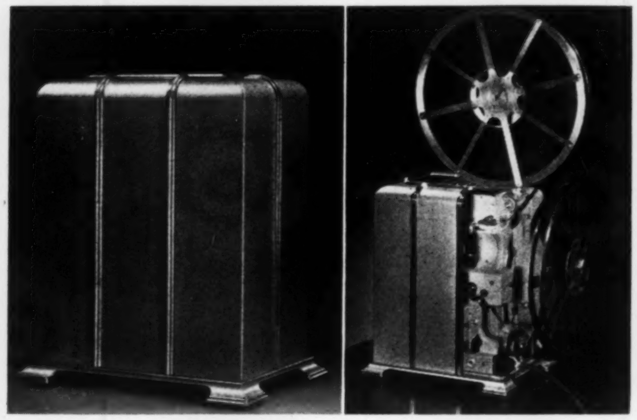


Hydraulic power in this plastic injection molding machine moves heavy molds at high speed

Styled Case Snaps Up Movie Projector

NUMEROUS technical advances and a bold departure from conventional projector design are embodied in a new 16-millimeter sound-on-film projector, the Sound Kodascope Special, recently announced by the Eastman Kodak Co. and shown in the accompanying illustration.

Compactly enclosed in a case of cast aluminum, which is opened when the machine is to be operated, the projector is finished in rubbed lacquer with vertical banding of gleaming chromium. Eight inches wide, eleven inches front to back, its casing rounds off in a graceful curve at the top. Height is less than sixteen inches.



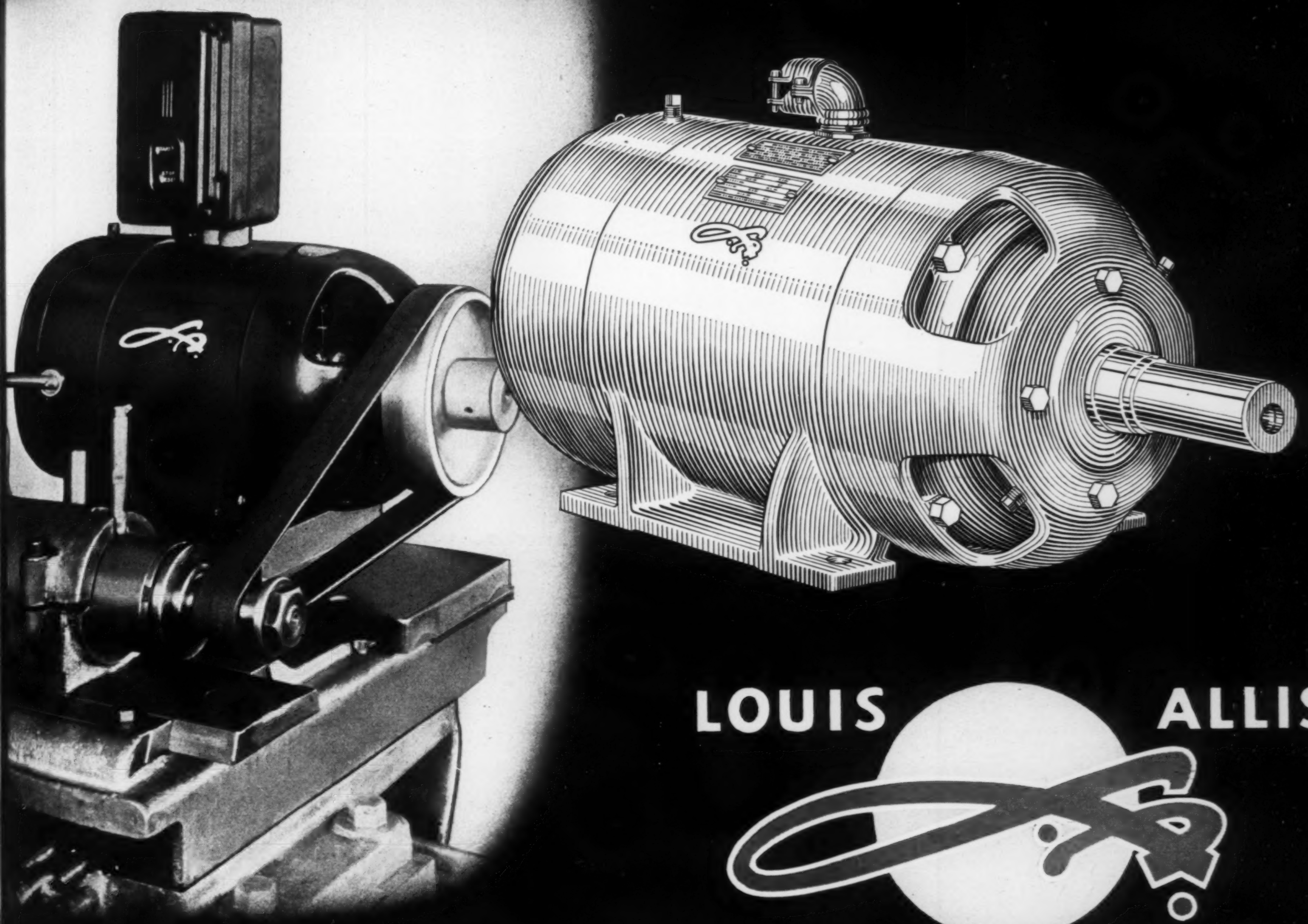
Neatly styled case of cast aluminum, shown at left, contains entire operating mechanism of the projector

The aluminum casing has a front portion hinged to give access to the threading mechanism, lens, and sound-optical system. There is no multiplicity of projecting parts and controls, but instead, a severe simplicity planned for utmost convenience of operation.

Film advance is effected by a single claw of special design which accelerates the film gradually, thus minimizing wear and lengthening film life. The operation of this claw is particularly quiet, a valuable feature in a sound projector.

Motive power is furnished by a large condenser-starting induction motor. The standard lamp is a 750-watt, biplane filament, pre-focus base, but lamps of lower wattage may be used. Reflector, condenser and projection lenses are designed to obtain maximum light efficiency. Forced ventilation is provided by an oversize fan, mounted directly on the motor shaft, which gives effective cooling with minimum operating noise.

Film drive mechanism is fully enclosed, although readily accessible, and runs in an oil bath. In addition to reducing wear this makes for quiet operation. During projection of a sound film the projector noise is minor, even in a small room.



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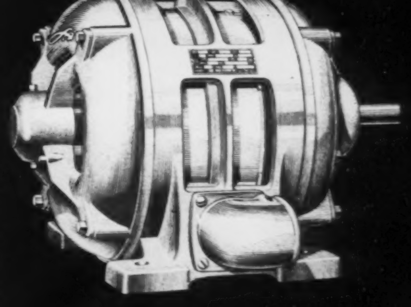
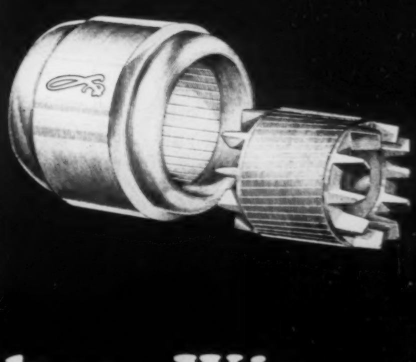
Speed variation has become a necessary feature in many types of productive machinery today. In Louis Allis multi-speed motors, two, three or four dependable speeds are available in a wide variety of mechanical modifications for every need. A descriptive folder will be sent upon request.



SHAFTLESS

The advantages and economies of shaftless built-in motors for machine tool drives are many. Catalog No. 700 contains very complete construction features, charts, tables and valuable engineering data regarding these motors. Write for your copy today.



The LOUIS ALLIS CO., Milwaukee, Wis.

Noteworthy Patents

BACK in the early days of the steam engine, when "walking beams" were in common use, it was a frequent goal for inventors to try to achieve true straight-line motion without the use of slides.

Today the walking beam again has become highly important in connection with oil pumping rigs and again this question of straight-line motion has come to the fore. How it has been attained in a simple and practical manner by one of our present day inventors is revealed by *Fig.* 1. This is the design of Albert N. Porter of Tulsa, Okla., whose patent—No. 2,113,281—has been assigned to J. F. Darby.

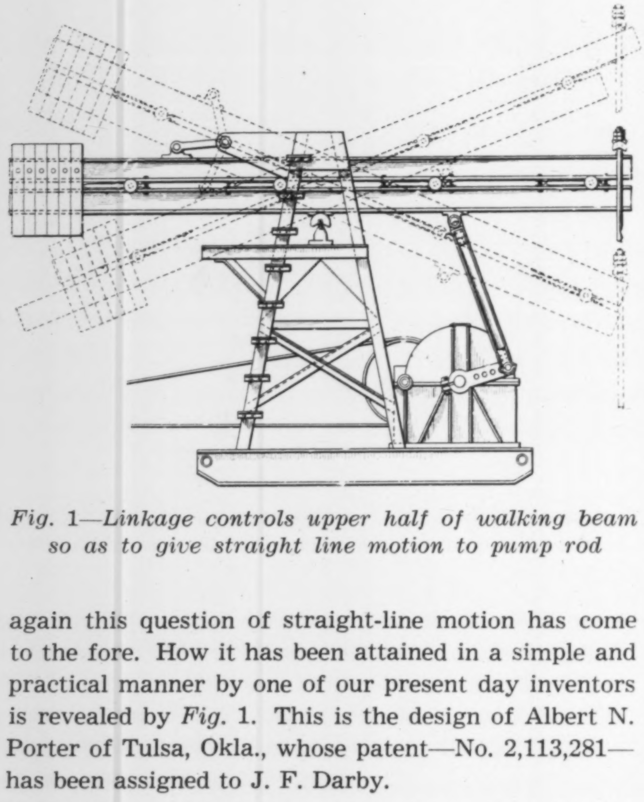


Fig. 1—Linkage controls upper half of walking beam so as to give straight line motion to pump rod

The effect of the linkage between the upper half of the split beam and the horn on the upright support is shown clearly by the diagram. As the beam rocks at its center the upper half is rolled back on the down stroke of the end to which the pump rod is fastened, and back on the upstroke. The result is that the pump rod moves straight up and down without the intervention of auxiliary guides.

Drive Is Compact

AN INTERESTING example of what can be achieved in compactness of a power transmission mechanism, through the use of roller bearings and one of the newer types of gearing, is given in *Fig.* 2.

This is a representation of a design developed particularly for geared locomotives by Tracy V. Buckwalter and Joel Hektner of Canton, O. This development is covered by patent No. 2,089,016, which has been assigned to the Timken Roller Bearing Co.

The drawing shows a section through a gear box located between the drive wheels of a locomotive—the axle of which appears in section at the center of the cut. The shaft carrying the pinion is the drive shaft, which through the use of hypoid or similar type of gearing is permitted to pass over the axle.

Positive alignment of the heavily loaded pinion is assured by the tapered roller bearings located close to it at both front and back. These are arranged to support it firmly in position against the endwise thrust due to action of the teeth. Double row bearings support the drive shaft at its point of exit.

The plate supporting the pinion is so designed that by removing it the drive shaft, its bearings and the pinion can readily be removed from the housing or inserted therein. This plate, which carries the outboard bearing of the pinion, is secured to a flared portion of the housing by means of cap screws.

While not apparent in the illustration, torque reactions imposed on this housing are resisted by a pair of vertically spaced parallel torque rods that connect one end of the housing with the cross frame member or bolster of the truck above and below the axle axis. Pivotal connections between torque rods and the

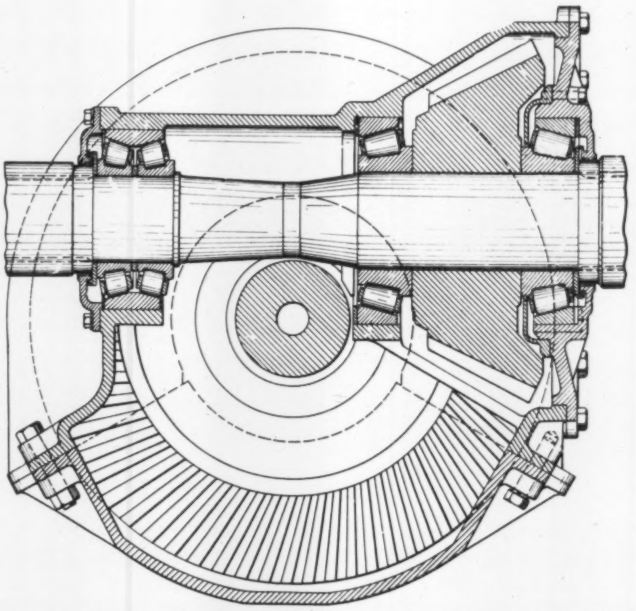


Fig. 2—Roller bearings and special gearing are vital factors in this compact locomotive drive

Whenever a flexible connector or conductor is needed . . .

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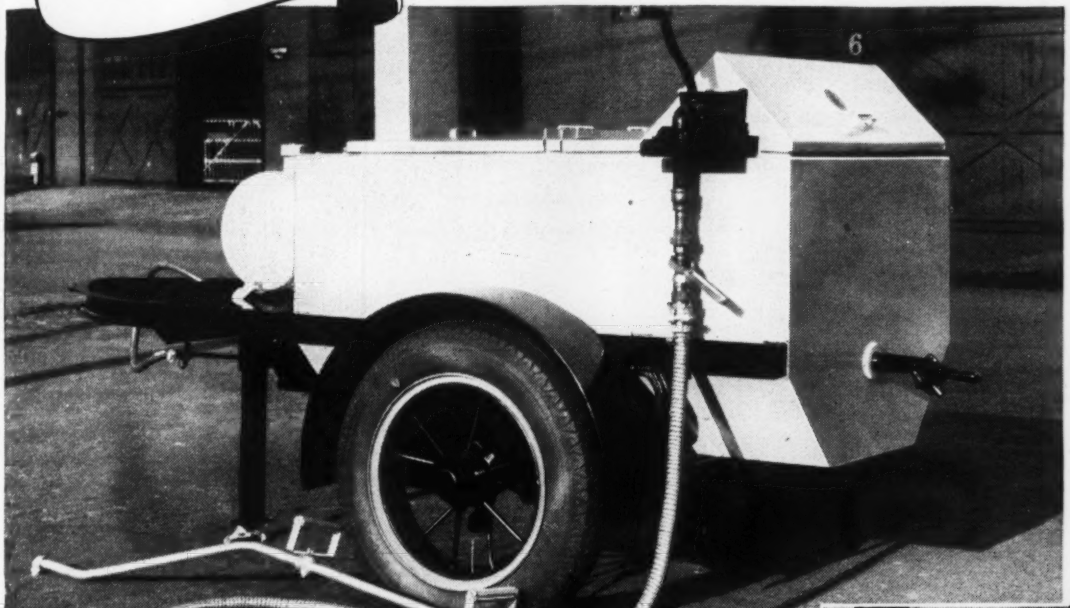
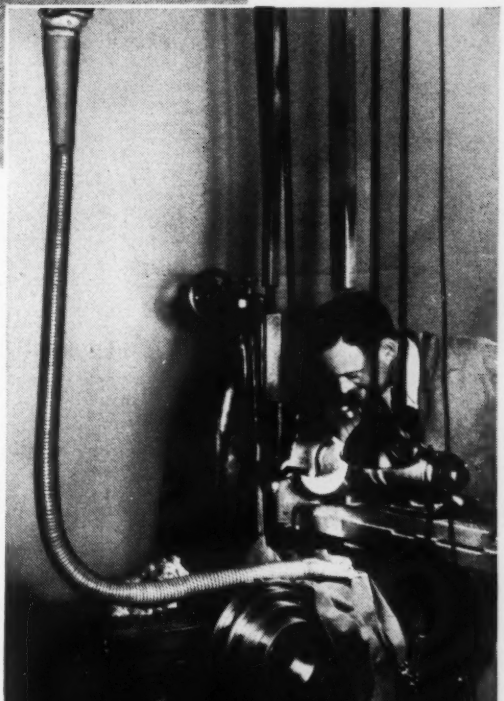


American Flexible Tar and Asphalt Hose . . . a standard with road equipment manufacturers.

ANACONDA
from mine to consumer

Interlocked Steel American Flexible Hose used for sucking dust from a grinder.



ILLUSTRATED here are two of the innumerable uses of American Flexible Metal Hose and Tubing in American industry. Whether it be suction hose for carrying away grinder dust . . . or leakproof seamless flexible tubing for conveying steam under high pressure—American has the answer and can fill the bill.

The ability of American Flexible Metal Hose to withstand successfully the most severe working conditions is recognized. That partly explains the reason why it is so widely used as standard equipment in maintenance and product design. Flexible Metal Hose saves money because it is quickly installed and gives better service over a longer period of time.

Maintenance engineers in steel mills, textile factories, chemical and glass plants ended their conveyance problems once they installed American Flexible Metal Hose and Tubing. Our engineering department will welcome the opportunity to discuss *your* requirements for flexible connectors of all kinds. Write us in detail about your problems. Send for Bulletin SS-3—packed with valuable information for your technical department. 38345

THE AMERICAN BRASS COMPANY

American Metal Hose Branch

General Offices: WATERBURY, CONNECTICUT

bolster and housing permit of limited relative movement of housing and bolster in both horizontal and vertical directions. The torque rods act something in the manner of the links of a parallel ruler.

Prevents Refrigerant Leakage

COMPRESSORS designed for use in refrigerating apparatus and the like are frequently driven by an electric motor connected to a suitable compressor shaft which extends through an aperture in the compressor housing. Since the compressor casing contains refrigerant vapor or other fluids, it is necessary to provide some sealing arrangement.

Such is the purpose of the seal depicted by *Fig.* 3, which has been patented by Ralph E. King of Fort Wayne, Ind. His patent, which is No. 2,100,220, has been assigned to the General Electric Co.

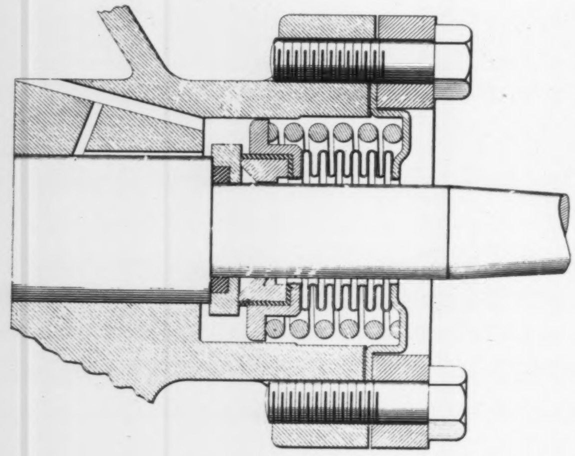


Fig. 3—This rotary seal is designed especially for refrigerating machines

As is rather clearly shown, the object of this invention is to provide a resilient seal between the relatively rotating sealing elements—this of a type which will not distort or deteriorate through contact with lubricating oil or refrigerant. The tendency toward leakage is outward, therefore the heavy coil spring presses the seal toward the line of pressure.

An annular ring of the resilient material Duprene is positioned under spring compression in the recess, thus forming a seal between the drive shaft and its collar, preventing relative rotation. A section of metallic bellows plays an important part in this assembly, forming a seal between the outer disk and the inner supporting collar. It holds the supporting collar, ring and the annulus together as a stationary unit.

Diesel Powered Hammer

HUGO CORDES of Altona, Germany, has been granted patent No. 2,093,634, covering a diesel power hammer. Two views of this device are shown in *Fig.* 4, that at the left being a longitudinal section with piston raised and that at the right being a section at right angles to the foregoing, with piston in striking position. The device is designed for use in conjunction with a pile driver.

The hammer body comprises an upper, a middle and a lower part. The lower part contains the hammer block, which is sealed by means of piston rings. This hammer block rests by means of a spherical surface upon an impact plate which is pinned to the hammer body in such a way that it has same longitudinal displacement as well as a certain degree of inclination relative to the center line of the hammer body.

In the lower part of the hammer body is the combustion chamber. The fuel pump is actuated by a curved lever and push rod. This push rod is driven downward by the impact body and is moved upward by a spring. The impact body is in reality a differential piston, both diameters of which are provided with piston rings. An abutment on the lower portion delivers the blow to the top of the hammer block.

In use, the winch rope of the pile driver is connected to the sliding rod in the top of the casing. When the rope is released this rod and its hooks drop down, engaging the coupling on the heavy impact body. This heavy body is then raised by operating the winch. When the hooks hit the top of the casing they release, dropping the body, hitting the hammer block and at the same time producing an explosion which drives the block up again and lifts the whole device by compressing air above the body. Once started the cycle repeats automatically for an indefinite period until the fuel is shut off.

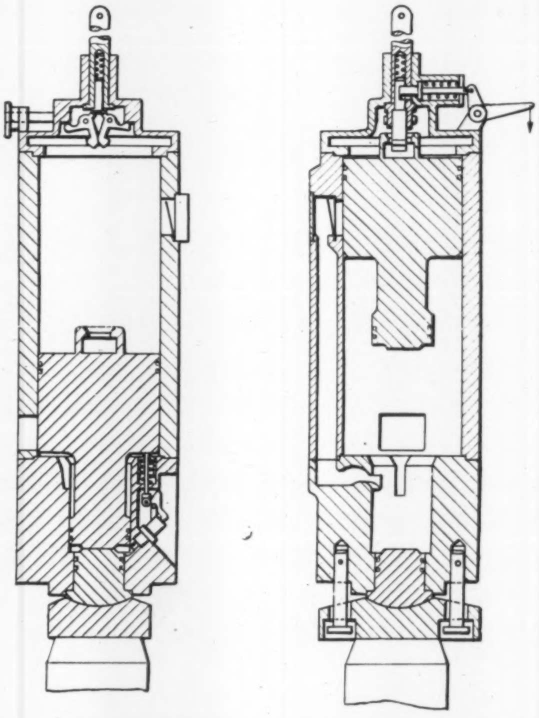
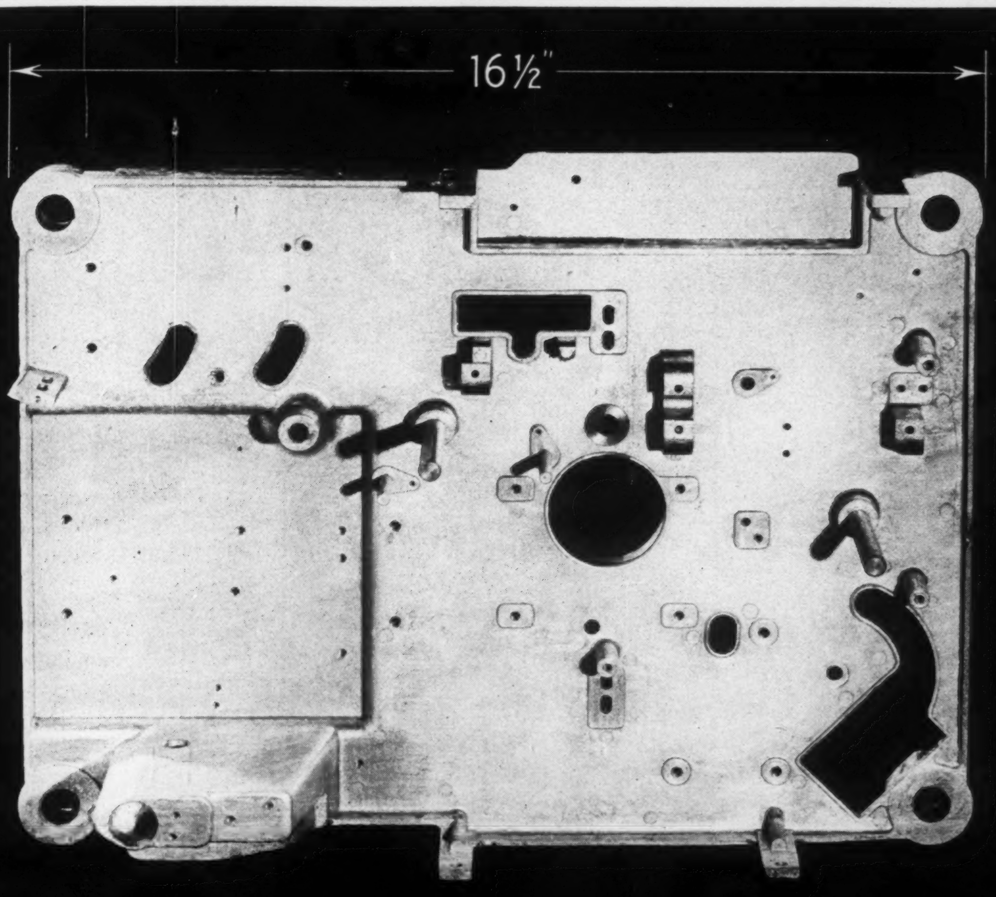
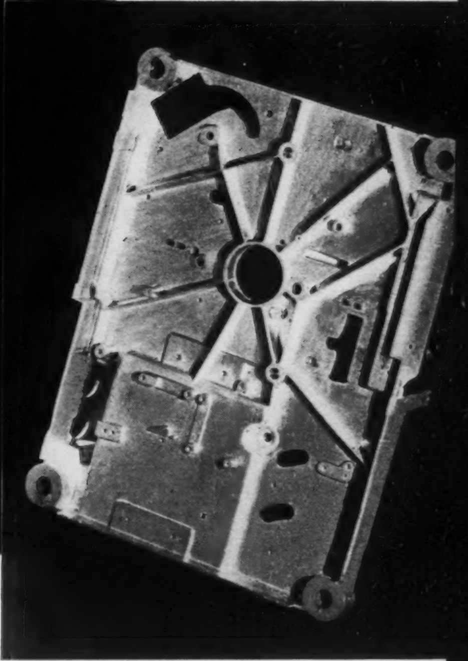


Fig. 4—Functioning on the diesel principle, this hammer is self-energizing

ZINC ALLOY DIE CASTINGS



IT'S DIE CAST!



—"There Was No Other Way"

The engineering staff that designed this ZINC Alloy Die Cast main frame for a Wurlitzer automatic phonograph reports that "from past experience we knew there was no other way." There were other available production methods, to be sure—but none offering the following properties with the economies of the die casting process:

1. **STABILITY AND STRENGTH**—This part is required to carry an unrelenting heavy load, and the intelligent design with strengthening ribs prevents any distortion in service.

2. **ACCURACY**—The main frame forms the nucleus of the entire mechanism of the phonograph, and many integrally cast lugs, bosses, blocks and posts are provided to mount the various elements. For this reason many dimensions must be held to tolerances as close as .002". And each casting in a long production run must maintain this accuracy!

3. **ECONOMY**—The engineers advise that any other production method would have involved 5 parts—with excessive machining and assembling costs. *As a ZINC Alloy Die Casting it is complete in a single, complex unit.* Further, the casting was designed to eliminate all idle weight—effecting a considerable metal saving.

Any commercial die caster will be glad to discuss ZINC Alloy Die Castings and their possible application in *your* products—or write to this Company.

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The Research was done, the Alloys were developed, and most Die Castings are specified with

HORSE HEAD SPECIAL (99.99+% UNIFORM QUALITY) **ZINC**

Where you're up against VIBRATION

. . . SPECIFY . . .

UNSHAKO

The Nut That Can't Shake Loose

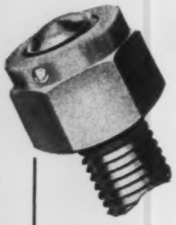


Fig. 1513
Pat'd. &
Pats. Pending

BECAUSE

it is sure locking. Whenever the slightest backing off tendency occurs the built-in locking-ring springs to life, effectively grasps the bolt or stud and holds the nut on tight.

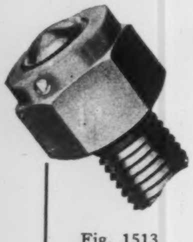


Fig. 1513
Pat'd. &
Pats. Pending

BECAUSE

it is a great time-saver. No extra pins or locking washers are needed. It turns on without the slightest trouble and with the help of a wrench it comes off just as easily.

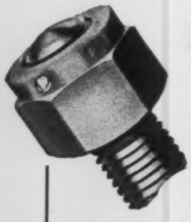


Fig. 1513
Pat'd. &
Pats. Pending

BECAUSE

it is neat in appearance. The absence of extra locking gadgets makes it appear little different from an ordinary hex nut, an important factor in the opinion of most designers, especially when they're for use on a manufactured product.

Write for complete descriptive literature

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA.

BOX 102

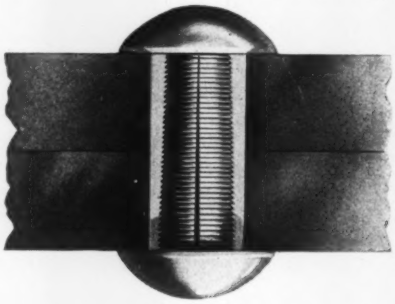
BRANCHES
BOSTON
DETROIT
INDIANAPOLIS

BRANCHES
CHICAGO
ST. LOUIS
SAN FRANCISCO

NEW Materials and Parts

Rivets Lock When Inserted

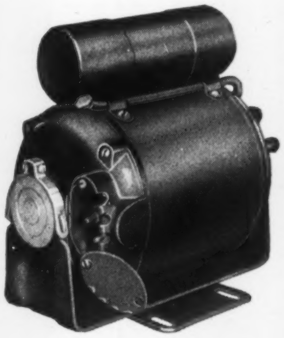
LOCKING rivets for solving special fastening problems, such as confined spaces, fragile materials or wherever heating, hammering or upsetting are impractical have been developed by Hopkan Rivet Co. Inc., 129 Latham street, Pittsburgh. These fasteners have a serrated split stud which locks within an internally serrated sleeve. The serrations—which are not threads—are formed with a vertical and tapered face. When the stud is forced into the sleeve the two halves of the stud come together at the slot. The serrations of the stud then lock into those of the sleeve, and the vertical faces latch so that they cannot be disengaged. Diameters are available from 3/16 to 1½ inches or larger. There is no limit to length. They are supplied in any metal and may be hardened or specially treated.



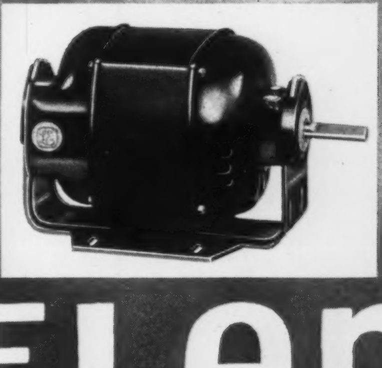
Forcing stud into serrated sleeve brings two halves together. Stud serrations lock with those of the sleeve when fully in place

High-Torque Motors Added to Line

ADDITION of high-torque, double-capacitor motors to their line of single-phase motors is announced by Wagner Electric Corp., St. Louis. New motors are designated as type RZN when equipped with rigid mountings and type RZNR when equipped with an-



Centrifugal switch located in motor changes capacitance value at approximately 75 per cent of load



LELAND IN AVIATION

It is no easy matter to satisfy the unusually rigid requirements of the aviation industry... yet Leland electric motors do it again and again.

As a typical motor application, we cite their adoption in portable testing equipment used by the U. S. Army for ground checking of instruments installed in airplanes. Another example ...this one in commercial aviation...is for similar equipment in use at various municipal airports.

Tear a leaf from aviation's notebook! If you have an application calling for a motor up to 5 H.P. . . . no matter what field it may be in . . . give it to the Leland of the required characteristics. Get one for comparison and test. The Leland Electric Co., Dayton, Ohio.

More Than 200 Fully Equipped Service Stations

LELAND MOTORS

OFFICIAL U.S. ARMY PHOTO

Brad Foote
REDUCERS

Continuous performance

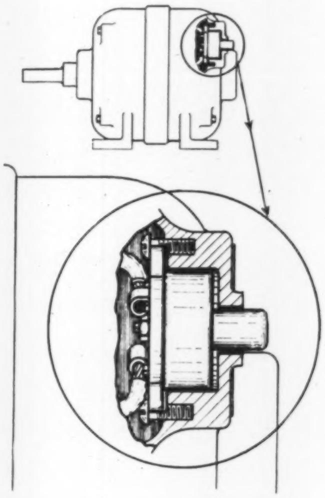
- Brad Foote Gears have always meant quality, long service and performance
- Any ratio—all horse powers and any ratio
- Made in one of the largest plants in the middle west—solely for cut gears
- Most modern plant equipment—many units specially designed
- Highest quality workmanship and materials
- Consulting engineer to help on your problems
- Write us to have our local representative call
- A reducer for every purpose

FOOTE GEAR WORKS INC.
1301-G. S. Cicero Av. Cicero, Illinois

nular resilient mountings. They are available in 110/220 volts in sizes of 1/3, ½, ¾ and one-horsepower ratings. Motors have two condensers of different values—a high capacitance value for starting and a low value for running. The change in capacitance occurs at approximately 75 per cent full-load speed by means of a centrifugal switch located in the motor. Other features of the motors are: High starting torque, low starting current, smooth running characteristics, quiet operation and good power factor and efficiencies.

Small Thermostat Protects Motors

OVERHEAT protection in fractional horsepower motors is now provided by a disk-operated thermostat brought out by The Spencer Thermostat Co., Attleboro, Mass. Device consists of a small thermostatic bimetal disk placed next to a heater wire. Contacts, welded to disk, provide positive action and, being placed in series with the line circuit, cause the thermostat to open and break the circuit. Thermostat protects the motor against overheating from any cause, yet breaks the circuits only when overheating is a definite danger to the motor. It is applicable over the complete range of single phase, alternating current, fractional horsepower motors up to and including one horsepower at 110 and 220 volts.



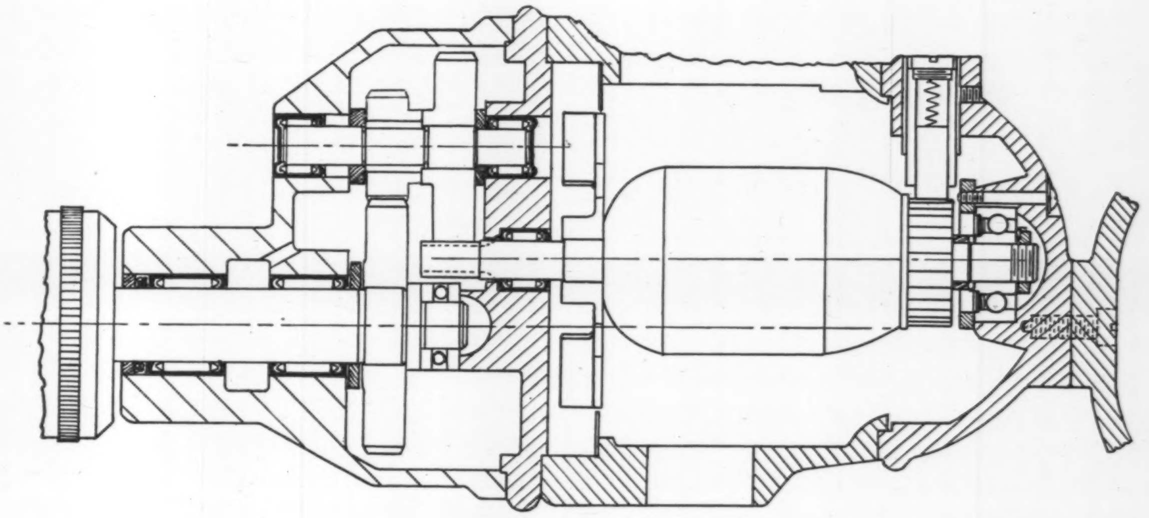
Thermostat protects the motor against overheating from any cause, yet breaks circuit only when excess heat is definite danger

Corrosion Resisting Solution Offered

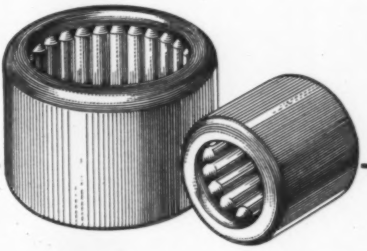
QUICK-DRYING solution which may be applied with brush or paint spray equipment to form a covering to resist corrosion of metal surfaces from liquids, gases or solids has been introduced by American Concrete and Steel Pipe Co., 4635 Firestone Blvd., South Gate, Cal. Known as Amercoat rapid-dry coating it differs from Amercoat enamel and Amercoat

TORRINGTON NEEDLE BEARING

DESIGN AND SERVICE FEATURES



ELECTRIC DRILL—A TYPICAL APPLICATION OF THE TORRINGTON NEEDLE BEARING IN HIGH SPEED ROTARY SERVICE



BEARING TAKES HEAVY LOADS AT HIGH SPEEDS

Ideal for Rotary Service

High load capacity in high speed rotary service is an important feature of the new Torrington Needle Bearing in such applications as the electric drill illustrated.

Because the bearing's full complement of small diameter needles permits heavy loading, small sizes can be used. Only the simplest type of housing construction is required—a marked aid in economical product design, particularly when several bearings must be mounted within limited space.

Low Unit Cost

The low unit cost of the bearing, coupled with housing economy, enables the manufacturer to utilize all the advantages of complete anti-friction construction—at a cost comparable to the use of simple bushings.

Lubrication of the Needle Bearing is simple and effective. The turned-in lips of the retaining shell hold an ample supply of lubricant for long periods of operation without service attention.

In the application illustrated, Torrington Needle Bearings carry the radial load of motor shaft, countershaft, and work spindle. Additional thrust capacity for the motor shaft and work spindle is provided by a single row Torrington Ball Bearing—a typical application illustrating the features of both types of bearings in a single design.

The Torrington Engineering Department will cooperate in the laying out of bearing applications. Further information is given in the Torrington Needle Bearing Catalog, available on request. Write for Catalog No. 9. Specifications on Torrington Ball Bearings may be obtained by requesting Catalog No. 401.

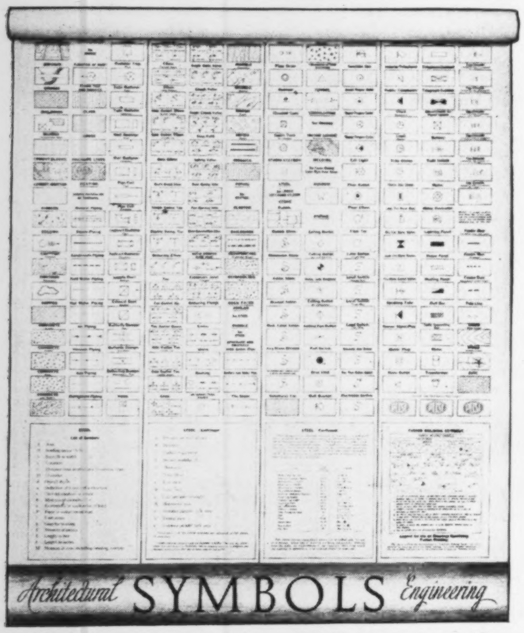
The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.
Makers of Ball and Needle Bearings
Branch Offices in all Principal Cities

TORRINGTON
NEEDLE BEARING

NEW
249 ENGINEERING & ARCHITECTURAL SYMBOLS CONSOLIDATED ON ONE CHART
FREE FROM FREDERICK POST

This brand new copyrighted 22" x 35" chart, first and only one of its kind, has the everyday and most of the "hard-to-find" architectural and engineering symbols all on one side — alphabetically arranged.

It is free to you if you are a regular member of an architectural or engineering organization or firm maintaining a drafting department. No obligations — A POST good will gesture.



[Limited space permits only partial illustration of chart]

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A "Double-Duty" Instrument

The Big Bow compass with only a 5" overall measurement easily and accurately *makes a 6⅜" circle.* A finely balanced "double - duty" instrument for hard use. Try one on approval.

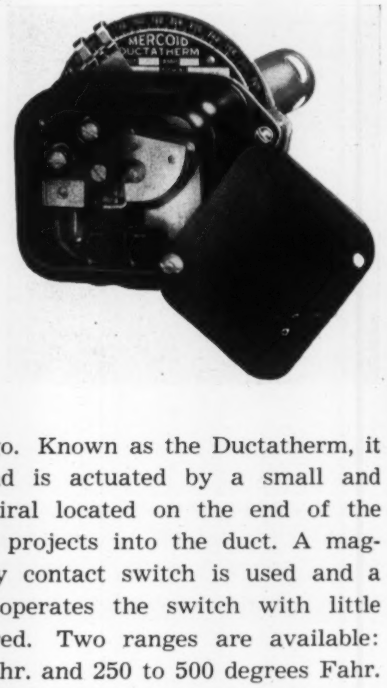
POST

INSTRUMENTS, EQUIPMENT AND MATERIALS FOR THE ENGINEER AND ARCHITECT. BLUE PRINT PAPERS AND KINDRED SENSITIZED PRODUCTS.

plastic, also made by the company, in that it is not particularly resistant to erosion and abrasion. This new coating will resist the action of acid and alkali and other types of corrosive agents up to 20 per cent concentration. It is insoluble in salt water and in petroleum derivatives.

Air Conditioning Temperature Control

TEMPERATURE control unit, designed especially for use in air conditioning ducts, as a limit or fan control for warm air furnaces and other industrial applications such as drying ovens and for temperature control of air or gas not injurious to brass has been developed by The Mercoid Corp., 4201 Belmont avenue, Chicago. Known as the Ductatherm, it is small in size and is actuated by a small and sensitive bimetal spiral located on the end of the control stem, which projects into the duct. A magnetic sealed mercury contact switch is used and a permanent magnet operates the switch with little energy being required. Two ranges are available: 50 to 300 degrees Fahr. and 250 to 500 degrees Fahr. It operates on 24 volts and 9/10 amperes.



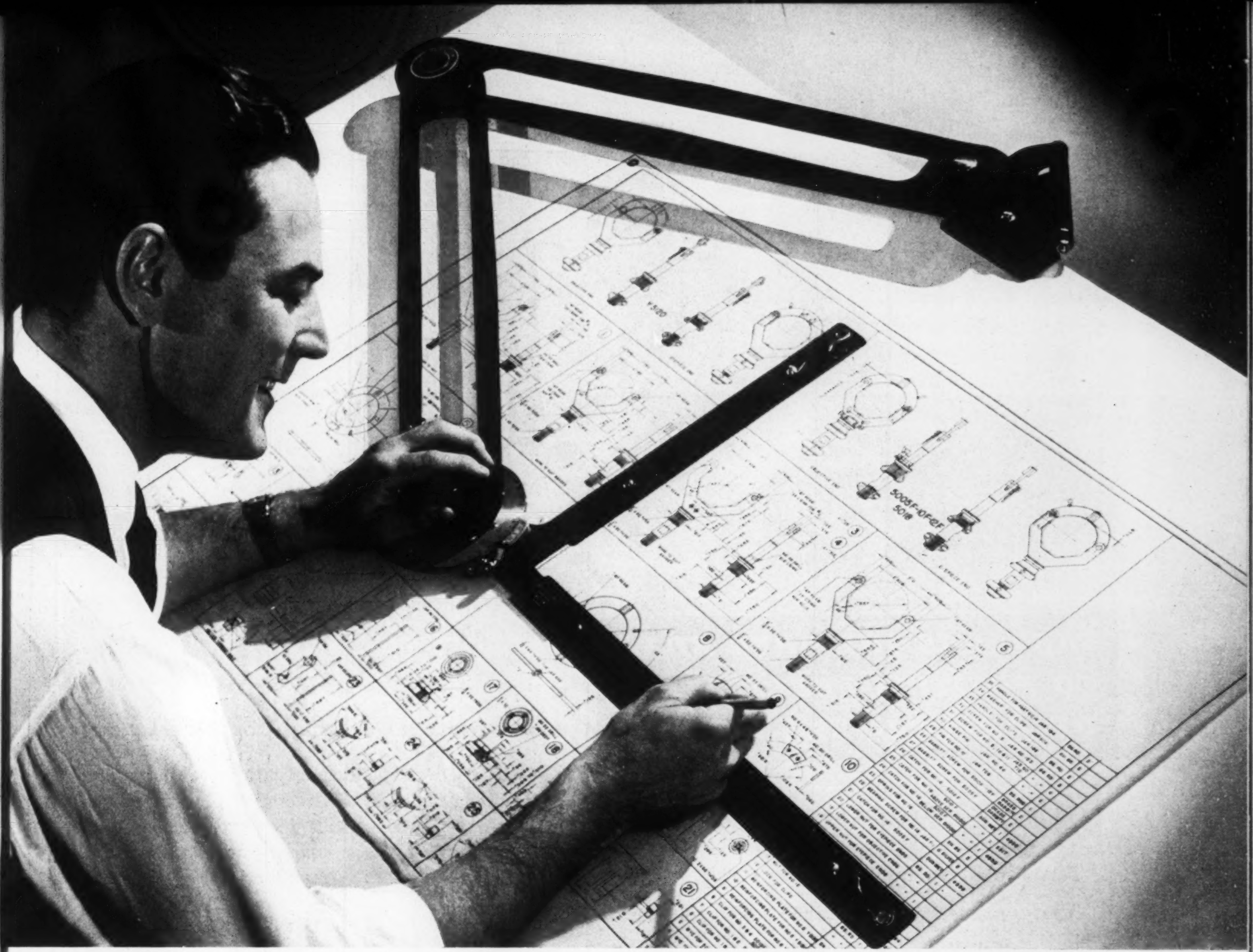
Small, heat sensitive temperature control has sealed mercury switch. It is available in two temperature ranges

Plastic Powder for Insert Molding

DEVELOPED to meet the problem of molding parts with especially large inserts which are subject to temperature extremes, a new molding compound has been announced by General Plastics, Inc., North Tonawanda, N. Y. Known as 2274, this compound is slightly more flexible than standard molding powders. Cracking is thus avoided in the finished piece which otherwise occurs with expansion and contraction of the metal inserts.

Phototube Relay Is Well Protected

BUILT for outdoor service in all kinds of weather, a phototube relay unit has been developed by G-M laboratories, Chicago. Complete protection from rain



CLEAR THE BOARD FOR ACTION!

No "table equipment" clutters your drawing surface when you use this improved drafting machine. T-square or straightedge, triangles, protractor and scales are all combined in one convenient unit—controlled entirely by the left hand. Hundreds of detail motions are eliminated to increase your drawing speed by 25 to 50 percent.

You will like the convenience of drafting the Paragon way. The head responds to a feather touch, giving you a horizontal *and* a vertical at any point on the board. A motion of the thumb lock produces any angle you require. All lines are drawn to exact length, along the scales, with no "tails" to erase later. Your drawing builds steadily, without distraction or interruption. No need to retrace, or duplicate efforts.

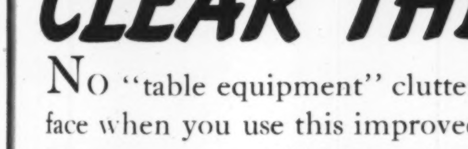
Give yourself the advantages of this advanced drawing method. Ask your K & E dealer to arrange a demonstration, or write for a copy of the new booklet.

EST. 1867

KEUFFEL & ESSER CO.

NEW YORK · HOBOKEN, N. J.

CHICAGO · ST. LOUIS · SAN FRANCISCO · DETROIT · MONTREAL

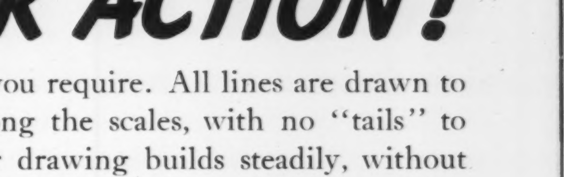


The positive automatic stop mechanism produces any multiple of 15° at a simple motion of the protractor control; odd angles are easily set on the vernier

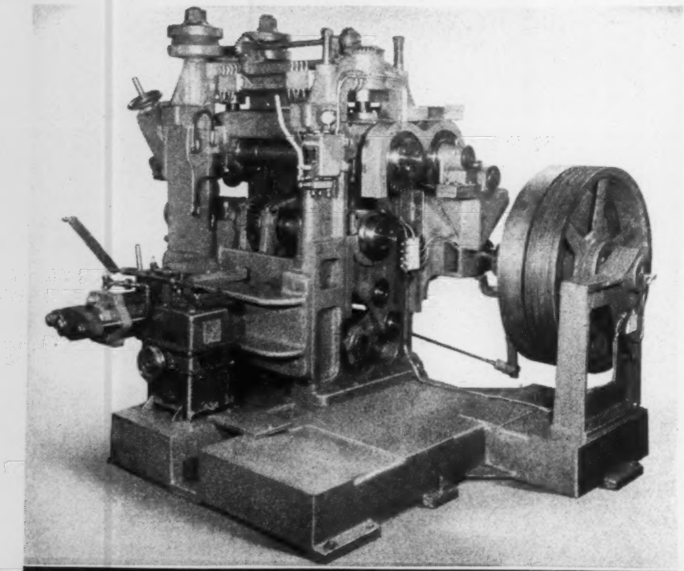
K & E PARAGON

REG. U. S. PAT. OFF.

DRAFTING MACHINES



All lines are drawn to exact length, along the scales.



FARVAL IS THE OPEN ROAD TO POSITIVE LUBRICATION OF *Every* BEARING . . .

THERE is no detour, no congestion, no one-way traffic, in the delivery of lubricant by Farval to all bearings.

Your customers can operate the equipment you build at top speed, continuously, without hazard of shutting down one machine or many for replacement of burned-out bearings. Farval lubricates each bearing *positively* and *correctly, and misses none.*

Farval Centralized Systems of Lubrication quickly pay for themselves and *continue* to earn for your customers, in other ways, too: by saving lubricant, eliminating labor of oiling, and reducing power consumption and repair bills.

Farval Systems will prolong the useful life of your machines and make them *worth more* to your customers. We will be glad to have our Representative call at your convenience. The Farval Corporation, 3265 E. 80th St., Cleveland, Ohio.

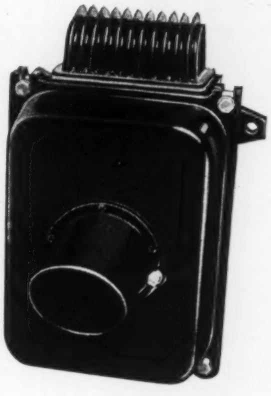
Affiliate of The Cleveland Worm & Gear Company, Manufacturers of Automotive and Industrial Worm Gearing.

FARVAL

CENTRALIZED SYSTEM OF LUBRICATION

Special Delivery to Every Bearing

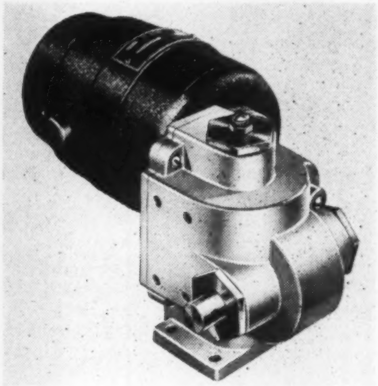
and snow is given by the heavy, watertight case and lens visor. A specially designed resistor is mounted in the top of the case with fins for dissipating heat. The unit is designed for 115-volt, direct current operation.



Protection from rain and snow is offered phototube relay by heavy, watertight case and lens visor

Gearmotor Designed for Overloads

DESIGNED for applications with more than ordinary load the EMC A-7 motor-driven gear reduction unit made by Electric Motor Corp., Racine, Wis., is equipped with oversize gears, shafts and bearings.



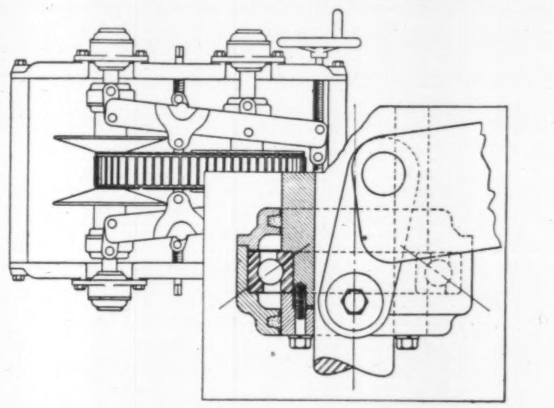
Oversize gears and shafts enable fractional horsepower gearmotor to withstand heavy overloads

The gear reducing unit may be used with motors which range from 1/500 to 1/15 horsepower. It will withstand terrific shock and the vibratory conditions surrounding many small motor uses.

Acetate Plastics Are Announced

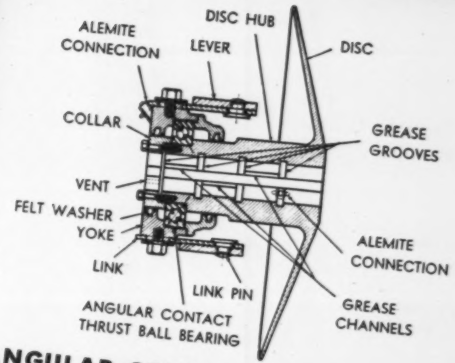
HIGH quality, acetate molding materials, producing parts of high resistance to impact, have been placed on the market by Bakelite Corp., 247 Park avenue, New York. Bakelite acetates are thermoplastic molding compounds with a cellulose acetate base and are recommended for both injection and compression molding. Manufactured in granular form in a wide range of colors, including crystal clear, black and variegated mottles, they are also available in trans-

Only LEWELLEN HAS THESE IMPORTANT FEATURES



FLEXIBLE BEARING SUSPENSION

that is self-aligning in every direction. In the Lewellen Lever and Link Suspension, the center of the link pivots upon a boss which is exactly central with the bearing. Therefore, the thrust load upon the bearing is equally distributed without regard to the position of the discs, as the support is always at the center of the bearing. The discs are moved by a positive, direct pull of the lever through the floating links upon the thrust bearing housing secured firmly to the disc hub. This insures an even distribution of the load upon each ball in the bearing at all speeds, or while changing speeds. When the lever is moved outwardly in changing speeds, the entire disc is moved through the lever and link, without depending upon the wedge action of the belt to force the discs apart. Speeds can be changed under full load with little effort, and with no strains or distortions.



ANGULAR CONTACT THRUST BEARINGS, mounted at the outer end of the disc hub, have a single, diagonal point of contact between the balls and the races. In this way the bearings provide for both the thrust load and the radial load set up by the high speeds of the shaft, and give a much greater load capacity than any other type of bearing. The lubricant seals for this bearing are within its radius, at the smallest diameter of the bearing housing. This, by means of the centrifugal force developed, prevents the lubricant from working out at the seals. The entire thrust bearing is enclosed in an oil-tight housing, which is attached to the main operating levers by suitable link connections, making the bearing self-aligning in every direction.

FEATURES THAT MEAN YEARS OF LOW-COST SERVICE

Here's a roll call of Lewellen's exclusive features. In addition to the flexible bearing suspension and the angular contact thrust bearings mentioned above only Lewellen offers a positive, patented lubrication system for disc hubs, keys, and shafts—the famous double block belt and unbreakable belt splice. Test after test have proven that these exclusive features in a Lewellen Transmission mean years of dependable, trouble-free service. Economize the Lewellen way by eliminating expensive repairs and replacements.

and you pay no more for

LEWELLEN VARIABLE SPEED TRANSMISSIONS

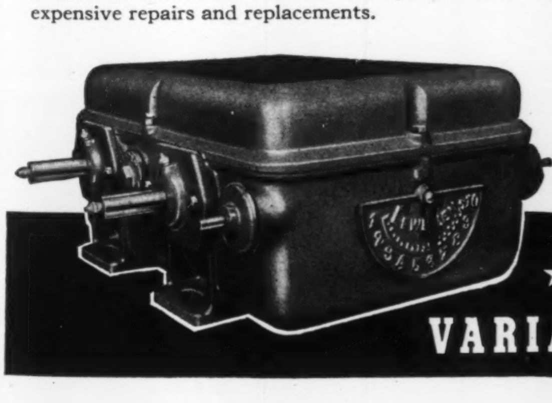
● We know you'll believe your own comparisons—that's why we're so eager to have you make a thorough inspection of the Lewellen. The precision, the capacity and the long life built into a Lewellen Transmission is the result of more than 40 years' experience in specialized speed-control engineering.

Decide NOW to improve your manufacturing operations with a Lewellen Variable Speed Transmission in the drive of each production machine. The result: INCREASED PRODUCTION AT LOWER COSTS and an IMPROVED PRODUCT.

The Lewellen is an extremely flexible unit that may be adapted to any variable speed control problem. THERE IS A LEWELLEN TRANSMISSION TO MEET YOUR NEED FOR VARIABLE SPEED CONTROL. Our engineers are ready to be helpful.

Call a Lewellen representative or write us, NOW!

LEWELLEN MANUFACTURING COMPANY, Columbus, Ind.



★ *Lewellen* ★

VARIABLE SPEED TRANSMISSIONS

No. 0388 B-D steel Roller Chain 2.609" pitch
No. 80-H (Extra Heavy) B-D Roller Chain 1" pitch

Bothered by
DIRT...GRIT?
use Roller Chain

Six years ago R. & B. Equipment Mfg. Co., bought their first Baldwin-Duckworth Roller Chain. Now their graders are 100% B-D as regards chains and sprockets. The model illustrated has four other B-D drives besides the two shown in the picture. They report: *No breaks in six years.* Be able to say that about *your* equipment!

Grit and dirt quickly destroy most power transmission equipment—but they have little effect on roller chain. If your product or any of your construction or manufacturing equipment operates under unusually severe conditions—a B-D sales engineer may be able to help you.

BALDWIN-DUCKWORTH CHAIN CORPORATION
Springfield, Mass.
Factories at Springfield and Worcester

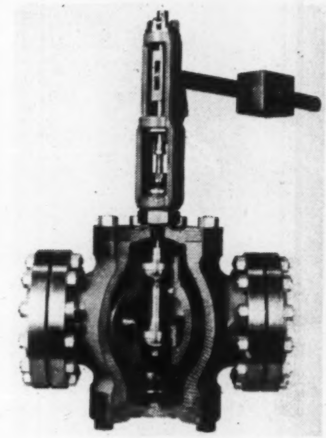
Call the **B-D MAN**

BALDWIN DUCKWORTH

parent, translucent and opaque colors. Acetate molding materials are custom made and, therefore, molding properties and finished material properties can be altered to suit specific applications. They are suitable for an infinite variety of uses, restricted only by the effect of heat and certain solvents.

Valves Have Easy Movement

FOR use with steam, air, oil, water and most gases, series 42 balanced lever valves are announced by A. W. Cash Co., Decatur, Ill. Type 42-R valve, illustrated, has the roller guided top works insuring free valve movement, perfect valve stem alignment, tight seating and a minimum of friction. Nitralloy rollers and roller pins are used. Seat rings are renewable and any type inner valve may be supplied. Valves are available in ordinary materials and in sizes from ½ to 3 inches, threaded ends; 1 to 12 inches, flanged ends.



Roller guided top works insure free valve movement, perfect stem alignment and a minimum of friction

Enamel Line Is Quick Drying

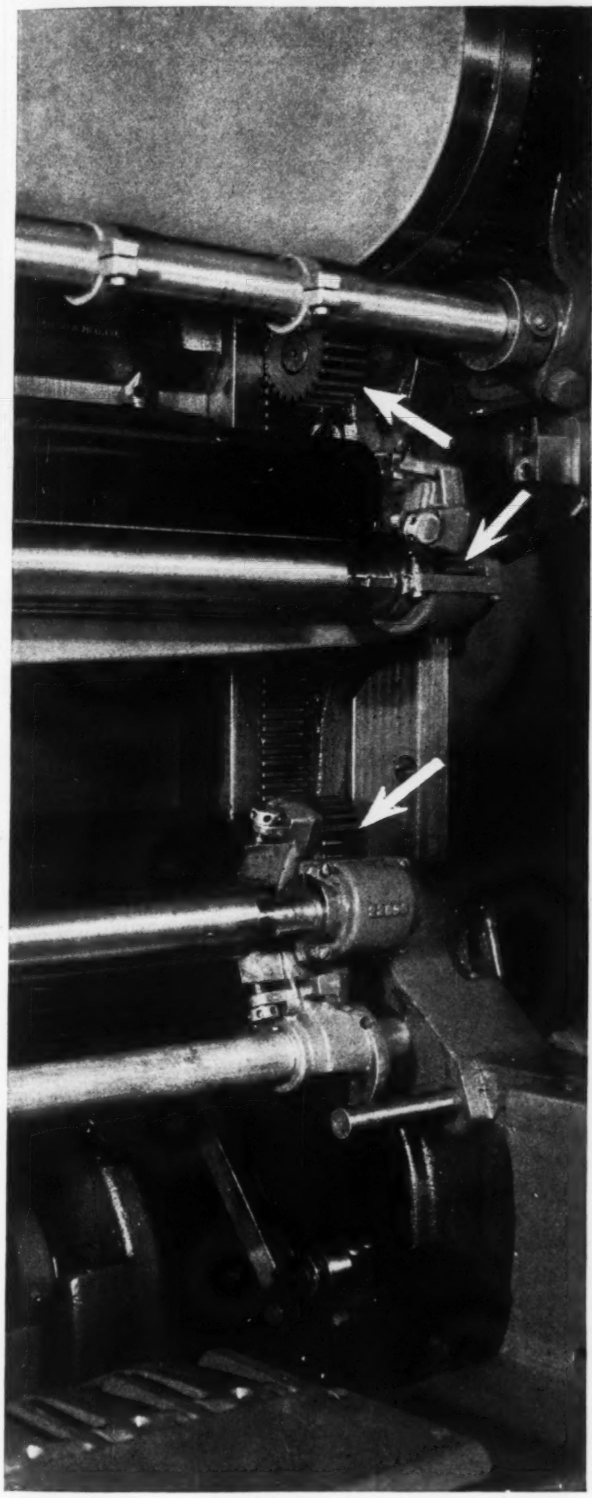
ENAMEL for industrial finishing is announced by the E. I. du Pont De Nemours & Co., Wilmington, Del. Known as short-bake "Dulux," this new finish greatly speeds production. Its shorter baking time (8 to 10 minutes at 350 degrees Fahr.) allows a greater output with smaller ovens. In addition to shorter baking time, the new finishing material has demonstrated satisfactory adhesion to metal and good hiding in one coat. It may be applied on solvent cleaned steel, bonderized steel or primed steel. It is available in white or colors.

Photoelectric Type Counter

COUNTING unit, of the photoelectric type, which, however, does not utilize an expensive light source but a standard mill lamp, has been placed on the market by Wayne Automatic Relay Co., Fort

FORMICA GEARS Quiet THIS PRINTING PRESS

●



These printing press gears, cut and installed by the Foote Gear Works, Cicero, Illinois, are typical of many Formica gear installations both by machinery manufacturers and maintenance men, who wish to reduce noise and make machinery operate more smoothly and efficiently.

Formica gears make machinery easier to sell and easier to take care of after it has been installed. Therefore the sales departments of machine manufacturers are strong for it, and the men in charge of maintenance in plants also find it a great help.

The material is elastic and intermittent and reversing action is less of a shock to the machine when there is a Formica gear in the train.

The gear cutters named on this page can give you prompt service on one or many gears.

FORMICA

THE FORMICA INSULATION CO.
4640 Spring Grove Ave. • Cincinnati, O.

FORMICA
GEAR CUTTERS

●

The Akron Gear & En'g Co.
Akron, Ohio
Farrel-Birmingham Co., Inc., Buffalo, N. Y.
Slaysman & Company
Baltimore, Md.
Harry A. Moore
Bangor, Me.
The Union Gear & Mch. Co.
Boston, Mass.
Chicago Rawhide Mfg. Co.
Chicago, Ill.
Perfection Gear Company
Chicago, Ill.
Gear Specialties, Inc.
Chicago, Ill.
Merkle-Korff Gear Co.
Chicago, Ill.
Chicago Gear Works
Chicago, Ill.
Foote Gear Works
Cicero, Ill.
The Cincinnati Gear Co.
Cincinnati, O.
Clarksville Foundry & Machine Co.
Clarksville, Tenn.
The Horsburgh & Scott Co.
Cleveland, O.
The Stahl Gear & Machine Co., Cleveland, O.
The Master Electric Co.
Dayton, O.
The Adams Company
Dubuque, Ia.
Hartford Special Machny. Co.
Hartford, Conn.
Beaty Machine Works
Keokuk, Ia.
The Generating Gear Co.
Milwaukee, Wis.
Badger State Gear Co.
Milwaukee, Wis.
Precision Machine Co.
Milwaukee, Wis.
E. A. Pynch Co.
Minneapolis, Minn.
Puritan Mfg. Co.
Omaha, Neb.
Joaquin Alemany Lopez
Havana, Cuba
New Jersey Gear & Mfg. Co.
Newark, N. J.
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New Orleans, La.
J. Morrison Gilmour
New York City
Sier-Bath, Inc.
New York City, N. Y.
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Osceola Mills, Pa.
Puritan Machine Co.
Omaha, Neb.
E. M. Smith Machine Co.
Peoria, Ill.
The Eagle Gear & Mch. Co.
Philadelphia, Pa.
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Springfield, Mass.
Winfield H. Smith, Inc.
Springville, N. Y.
Allinger Lander Company
Sodus, N. Y.
Charles E. Crofoot Gear Corp'n., South Easton, Mass.
Arlington Machine Co.
St. Paul, Minn.
Farwell Mfg. Co.
Toledo, Ohio
Diefendorf Gear Corp.
Syracuse, N. Y.
Batson Cook Co.
West Point, Ga.
Worcester Gear Works
Worcester, Mass.
Massachusetts Gear & Tool Co., Woburn, Mass.

●

WHICH ONE—
FOR YOUR
PURPOSE?

P&H HIGH EFFICIENCY, ELECTRIC MOTORS

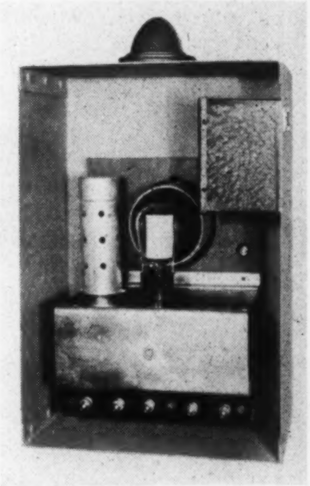
If your product is to deliver reliable service under all conditions, it deserves the proper motor, specifically suited to the work it does. Perhaps you, like many other manufacturers, will find the higher power factor and dependable operation of P&H Motors ideally suited to your own purposes. P&H high efficiency electric motors are built in a wide variety of sizes and types, to meet practically any requirement. If you have a special application problem, perhaps we can help you solve it. Why not write us? The Harnischfeger Corporation, 4556 W. National Avenue, Milwaukee, Wis.

Convertible slip-ring and squirrel-cage motors up to 250 h. p. capacity. Literature on request.

HARNISCHFEGER CORPORATION

MOTORS • HOISTS • WELDING ELECTRODES P&H ARC WELDERS • EXCAVATORS • ELECTRIC CRANES

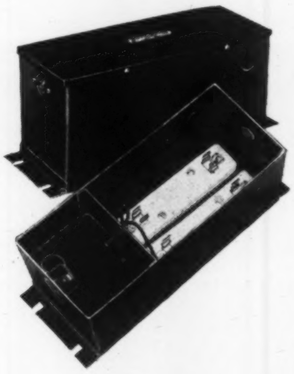
Wayne, Ind. Unit is wholly self-contained, has ingenious light louvre system to exempt all extraneous lights, and a highly corrected condensing lens to direct the full light energy upon the photo-cell. Atop steel cabinet is amber light that signals each step of counter cylinder, thereby protecting management against tampering or non-operation of unit. Three-quarters of an inch separation of parts will serve to actuate counter. It operates on either 110-volt direct or alternating current.



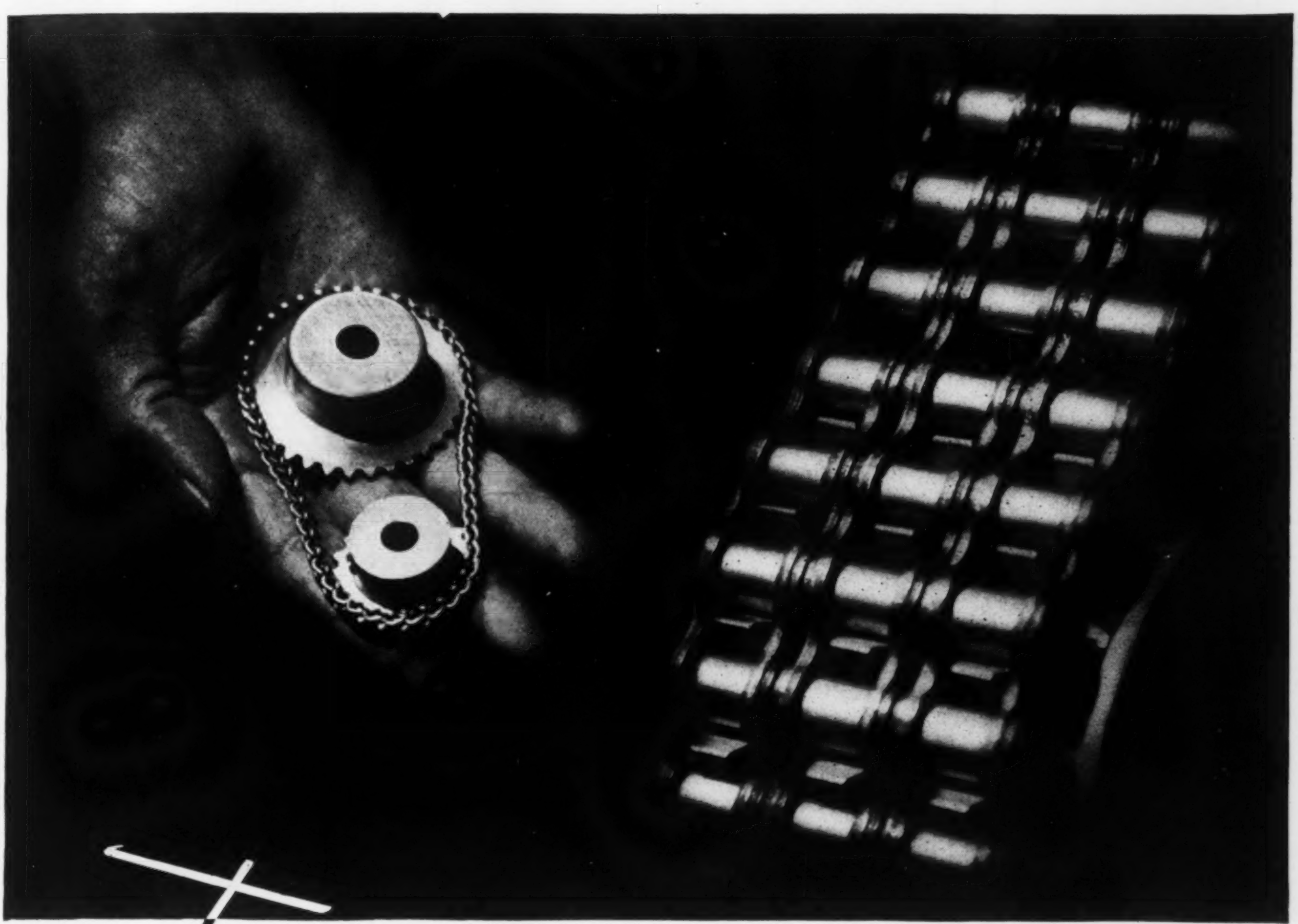
Light louvre system exempts all extraneous lights and condensing lens directs full light energy on photo cell

Lighting Transformer for Machines

ESPECIALLY designed to permit efficient, individual lighting of machines from high voltage power circuits, a transformer (type UL) has been announced by American Transformer Co., 178 Emmet street, Newark, N. J. Use of this unit permits elimination of separate lighting circuits, drop lights and excessive illumination in shops where machines are used. The type UL transformer is designed to be mounted as an integral part of the machine and have its input terminals connected to the high-voltage power circuit at the motor disconnecting switch. Units are available for use where the power-circuit voltage is 115, 230, 460 or 575 volts and supplies lamp voltage



Transformer is designed to be mounted as integral part of machine to step down line voltage for lights



From "flea" power to 100 horsepower

BOSTON GEARS

YES SIR, chain drives from "flea" power to one hundred horsepower and all from stock too. When you need chain drives in this range you know that if you buy from Boston Gear it will not be a matter of waiting days or weeks for delivery, because the chain and sprockets are in stock ready for your use. Seventy-seven pages of the new Boston Gear General Catalog #52 are devoted exclusively to these products. On these pages you will find your answer to chain and sprocket specifications, list prices, lubrication of chain drives, horsepower selection charts, and construction and list prices of chain cases. If you want one or more copies of our new General Catalog just let us know, we shall be glad to send you as many as you can use.

BOSTON GEAR WORKS, INC.
NORTH QUINCY, MASSACHUSETTS

SURE LOCKING

Fig. 1564
Pat. Applied for

There's not a chance that this set screw can work loose - - -

The knurling around the two top threads holds it in place and makes certain that it fulfills its duty . . . Thus is provided positive protection without resorting to special locking gadgets.

UNBRAKO

SELF-LOCKING HOLLOW SET SCREW

. . . have the full approval of industry. Nearly 3,000,000 of them have been sold for use in most all types of industrial production and maintenance.

Be sure to specify "Unbrako Self-Locker". Literature that tells just how it works will be sent you on request . . . also samples, if you desire.

Are you interested in saving space, materials and weight through the use of smaller flanges? Are you ever puzzled about getting screws into small spaces? Most designers who are, find an answer in the "Unbrako" Catalog. You may have one, too. Gratis.

Fig. 1434
Pat's
Pending

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA.
BOX 102

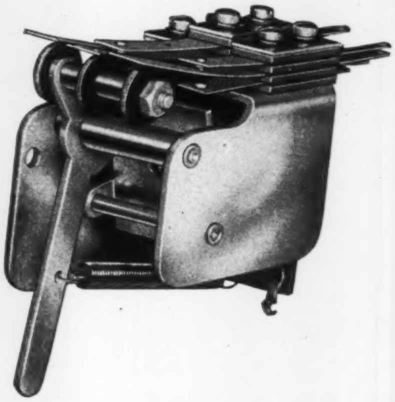
BRANCHES
BOSTON
DETROIT
INDIANAPOLIS

BRANCHES
CHICAGO
ST. LOUIS
SAN FRANCISCO

in 6, 32, 64 or 115 volts. Fuse block, connected in either the high-voltage or low-voltage line, is built into the transformer.

Circuit Breaker Relay Announced

CIRCUIT breaker relay, usable as an overload cutout, a manual reset annunciator drop and an off-level indicator in conjunction with a pendulum bob has been developed by G-M Laboratories, Chicago. It is intended for low voltage service up to 24 volts.

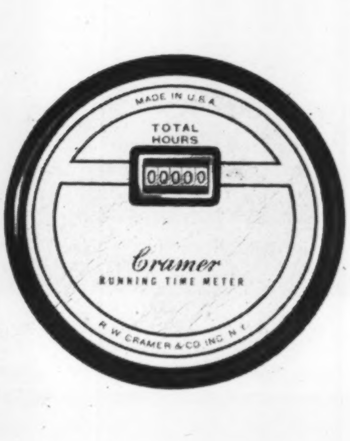


Three contact stack mounting positions permit three operating switches at single level

The three contact stack mounting positions permit three operating switches at a single level. Where necessary, additional contact combinations can be added to any one of the three stacks. It can be used in multiple assemblies with a common rest arm.

Summation Time Meter Announced

RUNNING time meter brought out by R. W. Cramer & Co., Inc., 68 Irving Place, New York, automatically registers the operating time of the circuit, apparatus or system to which it is connected. The meter is made in two types—one for registering total hours and one for registering total minutes. A five dial counter is used and indicates in tenths up to 9999.9 and repeats. In operation the meter is connected in parallel with the machine or apparatus of



Timer is driven by a slow-speed, self-starting synchronous motor and is built in type to register total hours and total minutes

"Daddy's Home On Time!"

G-E UNDIVIDED RESPONSIBILITY GIVES RANDALL

ONE SOURCE FOR ALL ELECTRIC EQUIPMENT

Relying on General Electric not only saves Randall's time but also assures his obtaining electric equipment with matched electrical characteristics—equipment designed to operate as a unit.

Moreover, no matter where Randall's machines may go, his customers will find a G-E service shop nearby for all types of electric equipment.

MR. RANDALL comes home on time almost every evening, now that he's quit stewing over the electrical end of his machines. He no longer wastes his time trying to patch together a number of different electrical proposals.

Instead, like many other wise machinery manufacturers, he delegates the undivided responsibility for the electric equipment on his machines to General Electric.

Take a Tip from Randall

By relying on General Electric, he doesn't have to trouble with a lot of electrical details. And when his machines are in the hands of his customers, he doesn't have to worry about the electrical end of them. No matter where they're located, he knows that G-E service will be close at hand.

If electrical problems prevent your giving attention to more important work, it's time that you tried letting us assume responsibility for the electric equipment. We don't promise that you'll get home on time from the office every evening. We do think, however, that we can save you many hours that you can devote to major problems. Just phone our nearest sales office. General Electric Company, Schenectady, New York.

GENERAL ELECTRIC

011-365

For High-grade Rubber-insulated Wiring Specify

VERSATOL
REG. U. S. PAT. OFFICE
PERFORMITE

It Has ALL THREE

Heat Resistance
75C

Savings in conductor size—and thus in cost and space—may result from the ability of Versatol Performite insulation to stand an operating temperature of 75 C.

Moisture Resistance
0.01

With the unusually low moisture-absorption factor of 0.01 gram per sq in., this compound is as waterproof as any rubber insulation can be.

Age Resistance
504

Being a superaging compound, this insulation can stand 504 hours aging in the oxygen bomb, which is said to approximate fifty years of natural life.

If your product requires a high-quality rubber-insulated cable, we recommend Versatol Performite. A cable specialist will gladly help you to determine if it does meet your requirements. Address nearest G-E sales office, or General Electric Company, Dept. 6B-201, Schenectady, New York.

Always the RIGHT Type for Each Product

GENERAL ELECTRIC
520-152

which the total operating time is to be registered; the synchronous motor starts and runs continuously while the machine or device is operating. Housing is made of molded Bakelite available in black with silver dial or brown with bronzed dial. The meter is particularly designed to record the actual operating time of processing and production machines, X-ray and diathermy apparatus, radio transmitters, textile and paper machinery, blowers, welders, etc.

Hose Lining Is Synthetic Rubber

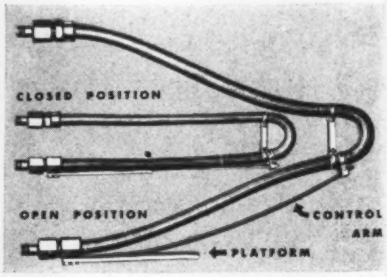
CONSTRUCTED with an inner tube of gas and oil-proof synthetic rubber, air drill hose for use on compressors and other equipment where oil may be blown into the hose has been brought out by The Manhattan Rubber Mfg. Division of Raybestos-Manhattan Inc., Passaic, N. J. Known as Grenadier-G. O. P. air drill hose, it is well constructed with two or three braids of strong, long staple cotton cord. Between these are placed sheets of live rubber which vulcanization forces into the cord, forming one inseparate unit. Smooth, uniform bore of hose tube permits a free flow of a large volume of air. Hose is available in all regular sizes from ¼ to 2 inches.

THE
MANHATTAN RUBBER MFG. CO.
BRAIDED
GRENADIER
AIR HOSE
PASSAIC NEW JERSEY

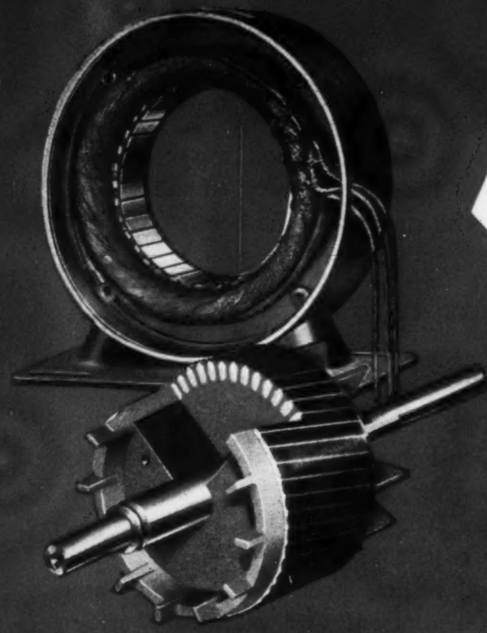
Live rubber is placed between braids of cord and vulcanized together forming inseparable unit

Regulates Hose Flexing

FOR automatically regulating the flexing of hose connections on platen presses and machines having similar problems, a type of Flex-Control (patent pending) has been introduced by the Packless Metal Products Corp., Long Island City, N. Y. The device is applied to seamless flexible metal hose fitted with self-sealing couplings—the entire connector unit being known as the Flex-Control self-draining hose. The device consists primarily of a small, compact platform and control arm rigidly fastened to coupling. They



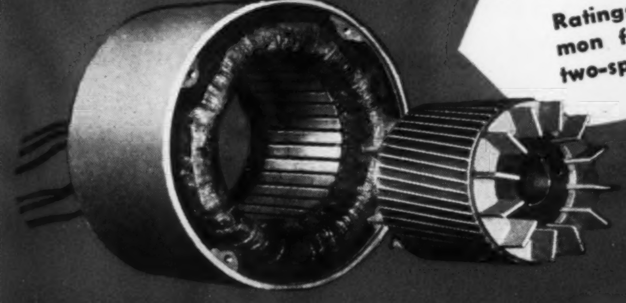
Small, compact platform and control arm rigidly fastened to coupling are principal elements of device for regulating the flexing of hose



POLYPHASE MOTORS
1/4, 1/3, 1/2, or 3/4 hp,
1725 or 3450 rpm

SINGLE-PHASE MOTORS
Split-phase motors—1/4 hp, 1725 rpm
Capacitor-motors—1/3, 1/2, or 3/4 hp, 1725 or 3450 rpm; also 1 hp, 3450 rpm

HIGH-FREQUENCY MOTORS
Ratings up to 3 hp in common frequencies, one- or two-speed windings



STURDY MOTOR PARTS *That Help Lick Tough Jobs*

GENERAL ELECTRIC has a complete line of motor parts for those applications where, to reduce size and weight and to improve appearance and efficiency, the motor frame or end flanges and bearings are made a part of the driven device. Parts with extremely high starting torques for table feeds, parts rated up to 1¾ hp at 3450/1725 rpm for tapping machines, and reversing-type-motor parts are typical of the variety available. General Electric can also furnish 25-cycle, 50-cycle, and d-c parts that are interchangeable with 60-cycle parts.

G-E motor parts receive the same careful attention as complete motors. They are designed with ample overload capacity and are built for long, quiet operation. Contact the nearest G-E sales office, or write to General Electric, Schenectady, N. Y., for additional information.

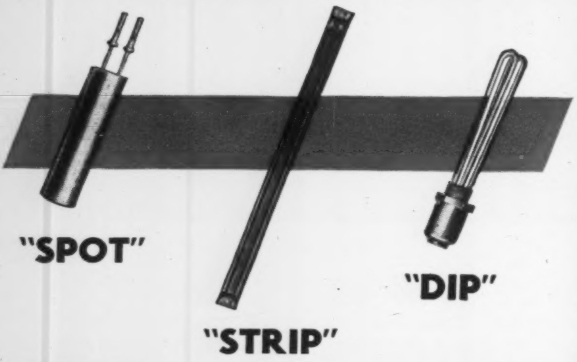
"Just the Ticket" for These Applications

- Clamping devices
- Coolant pumps
- Drill presses
- Floor machines
- Food-preparation equipment
- Grease guns
- Lifts and hoists
- Paint sprays
- Screw drivers
- Table-feed machines
- Tapping machines
- Textile machinery
- Woodworking machines

GENERAL ELECTRIC

[illegible]

Which of These Three Handy Electric Heating Units Can You Use?



"SPOT" Build this reliable electric unit into your machinery where localized heat is necessary. Properly applied built-in heat increases machine and process efficiencies, conveniently supplying regulated heat just where it is needed.

Applications: Bottle-capping machines, branding irons, cellophane-sealing machines, chemical machines, cigarette-making machines, embossing machines, presses, typecasting machines, package-wrapping machines, shoe machines, etc.

"STRIP" Where uniform heat distribution is needed, strip heaters will fit into your processing. They are easily installed, alone or in groups, for clamp-on or space heating.

Applications: Industrial ovens, warming tables, air heaters, fruit-waxing machines, incubators, matrix scorchers, sterilizers, beer-vat dryers, and packaging machinery.

"DIP" is used for heating all kinds of liquids in almost any quantity. Calrod construction makes it clean and safe. No need to pipe expensive steam from remote sources.

Applications: Airplane tenders, brooders, candy-coating machines, coal-treating machines, dairy sterilizers, glue converters, cleaning tanks, oil-heating equipment, etc.

Automatic Control: A thermostat connected with your electric heating units assures consistent and automatic temperature regulation. Your customers will appreciate the added convenience. General Electric Company, Schenectady, New York.

GENERAL ELECTRIC
160-55

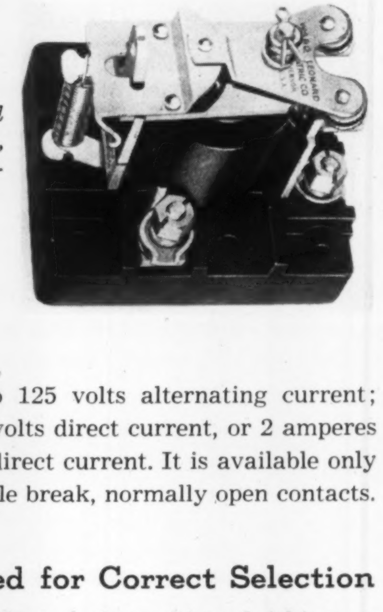
are designed both to take slack and water pockets automatically out of the hose, thereby effecting positive drainage and also supporting the hose.

Steel Resistant to Fatigue, Corrosion

POSSESSING unusual resistance to fatigue, impact and corrosion, a new high-strength, flat-rolled steel, known as Dyn-el, has been developed by Alan Wood Steel Co., Conshohocken, Pa. Dyn-el has all of the static and dynamic properties and resistance to corrosion necessary for high stress design, plus the advantage of low cost. This steel is particularly applicable to railroad rolling stock, trucks, buses and other automotive equipment and stationary structures where increased life due to resistance to corrosion is desired. Welding properties of the material are good.

Heavy Duty Midget Relay Announced

HEAVY duty midget relay, furnished with extra large, fine silver-to-silver contacts, has been placed on the market by Ward Leonard Electric Co., Mount Vernon, N. Y. The relay has a maximum rating of 10 amperes up to 125 volts alternating current; 10 amperes up to 22 volts direct current, or 2 amperes from 23 to 125 volts direct current. It is available only with single pole, double break, normally open contacts.



Relay is furnished with single pole, double break, normally open contacts

Paints Tabulated for Correct Selection

FOR low cost product and machine finishing, a series of four production black baking enamels, grades A, B, C, and D, are offered by The Sherwin-Williams Co., Cleveland. Ratings for performance and service have been determined by thorough testing and have been tabulated to show values developed at various baking temperatures. This enables the manufacturer to select the enamel and the finishing procedure best suited to the expected service of his machine. Production enamel "A" is preferred by many users as it bakes to a high gloss without being so sharp as to accentuate surface imperfections. Enamel "B" is

Announcing

A TIMING RELAY

That Defeats Frictional Wear

•

THE combination of a radio tube and a condenser in this timing relay takes the place of the usual escapements and moving parts.

Its only moving parts are the long-lived telephone-type contacts, good for millions of operations. Replacement of the standard radio tube is the only maintenance necessary.

Time adjustment, by the convenient knob in the cover, provides a smooth, stepless range of 5 to 100 per cent of the maximum time. Standard timing relays provide maximum time ratings as low as 0.9 seconds or as high as 120 seconds. (Slight inverse time variation with voltage fluctuation.)

Here's an idea that you'll want to consider for your designs — for processing machines, cycling or sequencing operations, or for other timing jobs. It's the answer where you want a long-lived timing relay with convenient adjustment.

Why not clip and mail the coupon *now* for a new publication giving full data? General Electric, Schenectady, New York.

GENERAL ELECTRIC
VACUUM TUBE
TIME DELAY RELAY
CR7504-A1A CAT. 5363391G2
115/230 VOLTS 50/60 CYCLES
CONNECTIONS K-5902999
CAUTION! BEFORE INSTALLING OR OPERATING READ INST. GEH-1033
SCHENECTADY, N.Y. MADE IN U.S.A.
.2
.3
.4
.5
.6
.7
.8
.9
1.0
0
1
MAXIMUM TIME
SEC AT 115 V
SEC AT 230 V

The new CR7504-A1A vacuum-tube timing relay uses a dependable radio tube and a condenser in place of escapements and moving parts

Price—$28

NEGLIGIBLE MAINTENANCE

STEPLESS TIME ADJUSTMENT

SAME TIMING FOR YEARS

Dept. 6B-201, General Electric
Schenectady, N. Y.

Please send me a copy of the new publication, GEA-2902, on CR7504 vacuum-tube timing relays.

Name ....

Firm ....

Address ....

080-147

GENERAL ELECTRIC

Be Materials Minded!

● Guesswork often is costly in the selection of materials. Today's requirements demand careful analysis of problems pertaining to the use of the proper material to serve the requirements of machinery in service. The engineer in charge of design must be materials minded—he must know what to use.

To assist its readers MACHINE DESIGN periodically compiles a Directory of Materials which gives information essential in making a wise selection from the large number of metallics and nonmetallics being produced. A limited number of copies of the directory still is available.

The current (Fifth Edition) Directory of Materials contains upwards of 1100 material listing in 48 pages of descriptive and analytical data on iron, steel and nonferrous alloys, plastics and other nonmetallic materials, as used in the design of machinery of all types and sizes. In addition to the alphabetical listing of tradenamed materials and the comprehensive selection guide to principal properties, the new Directory contains a cross-reference listing of materials under the names of producing companies.

A special schedule of rates in quantities has been established. All orders are filled in order of their receipt and copies are sent postpaid.

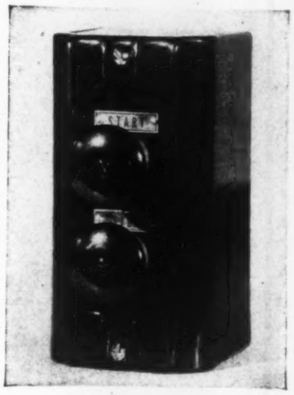
Number of Copies	Price Per Copy	Total
1	25c	$0.25
10	20c	2.00
25	18c	4.50
50	16c	8.00
100	15c	15.00

MACHINE DESIGN
Penton Building Cleveland, Ohio

similar to "A" but with lower gloss. Enamel "C" can be air dried or baked and provides the sharpest gloss. Enamel "D" is the dull finish of the group.

Pushbuttons Are Easily Operated

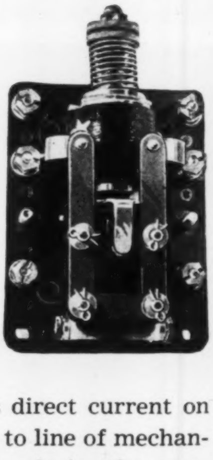
HEAVY duty pushbutton stations with mushroom type of operating heads for use where it is necessary for an operator to open or close a circuit by means of his elbow have been placed on the market by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This provides an ideal emergency stop since the button can be operated easily by pushing against the mushroom head with any part of the body.



Large mushroom type pushbutton allows operator to make emergency stop by brushing against device with any part of his body

Overload Relay Used on D.C. or A.C.

OVERLOAD relays, available for use on either direct or alternating current, have been developed by Struthers Dunn Inc., 139 North Juniper street, Philadelphia. Contacts are rated at 30 amperes at 110 volts, alternating current; 20 amperes at 220 volts, alternating current; 6 amperes at 110 volts direct current, and 3 amperes at 230 volts direct current on non-inductive loads. Relay is similar to line of mechanical latch-in electrical reset relays made by the company. Contacts can be arranged to be closed manually or by means of a voltage-operated coil and when closed, they latch closed. Latch to pick up and open the con-



Contacts can be arranged to be closed manually or by voltage-operated coil, and when closed they latch

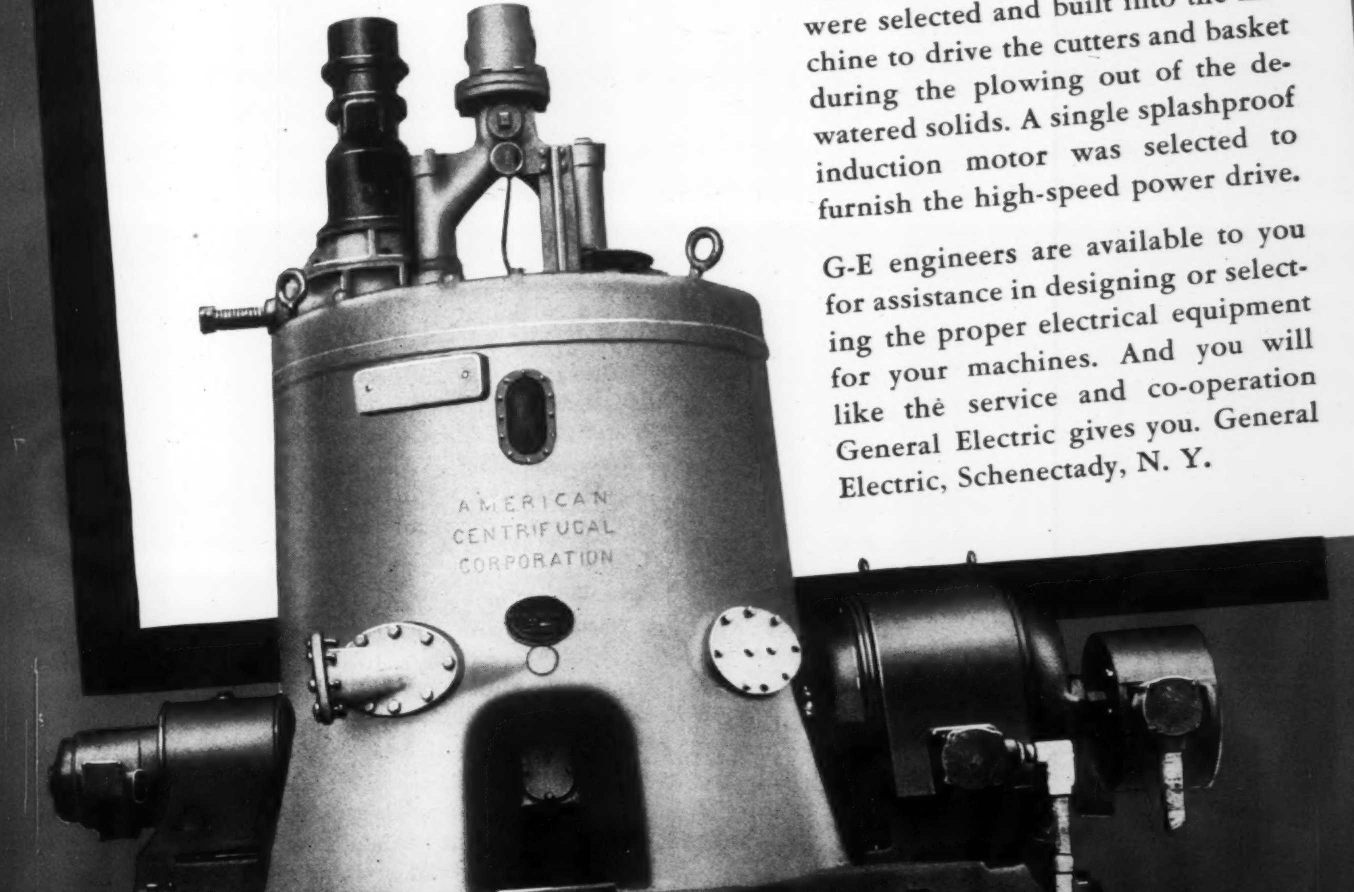
CASE STUDIES OF CO-OPERATION IN BUILDING BETTER MACHINES—NO. 5

HOW *a Design Problem* Was Simplified by the Use of G-E GEAR-MOTORS

THE American Centrifugal Corporation has been pioneering in the construction of centrifugal machines to be used for sewage-disposal operations and other industrial dewatering work. During the experimental and developmental period G-E engineers co-operated with the machine designers in selecting motors and control that would simplify design problems and still perform the exacting and specialized tasks.

Two G-E splashproof gear-motors, one vertical and one horizontal, were selected and built into the machine to drive the cutters and basket during the plowing out of the dewatered solids. A single splashproof induction motor was selected to furnish the high-speed power drive.

G-E engineers are available to you for assistance in designing or selecting the proper electrical equipment for your machines. And you will like the service and co-operation General Electric gives you. General Electric, Schenectady, N. Y.



Centrifugal sludge-dewatering machine built by the American Centrifugal Corporation and powered by a G-E induction motor and two G-E gear-motors

GENERAL ELECTRIC

020-361

"WHERE ENGINE FAILURE
IS NEVER EXCUSED"

This oil field equipment must be extremely light in weight but withal reliable.
So Wisconsin air-cooled power is specified.
★ FURTHER DETAILS UPON REQUEST

Made in Nine Sizes
Single and Four-Cylinder Models
1 to 28 H. P.

HEAVY DUTY AIR COOLED ENGINES by WISCONSIN MOTOR CORPORATION

WISCONSIN
MOTOR CORP., MILWAUKEE, WIS.

REDUCERS
Worm and Spur

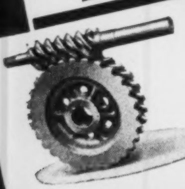
Many Types And Capacities In Stock.

ABART DESIGN
Abart Design produces a Reducer lighter per horse power delivered—without sacrifice of durability or strength.

ABART MATERIALS
Abart Worm Type Reducers have ground alloy steel worms, nickel bronze wheels. The gears and shafts in Abart Spur Type Reducers are made from heat-treated nickel chromium steel.

ABART WORKMANSHIP
Abart products are finished off to the smallest detail.

ABART GEARS
Precision cut; any material, type or quantity. *Write for new Speed Reducer Catalog.*



Abart GEAR AND MACHINE CO.
MANUFACTURERS OF
Speed Reducers & Gears
4821 WEST 16TH ST CHICAGO, ILLINOIS

tacts when coil current reaches proper value is adjusted by nut on top of relay over a range of 2 to 1.

Long-Lasting White Enamels

LINE of white baking finishes, known as KEM appliance enamels, which have color stability under baking temperatures higher than usually feasible for white enamels has been placed in the market by Sherwin-Williams Co., Cleveland. Application of the paint is easy and its exceptional build and opacity make possible a rich finish of unusual beauty. It is said to afford maximum resistance to discoloration under exposure to extremes of light, humidity, grease and chemicals. These enamels are offered in both high and intermediate baking types to meet various requirements.

Meetings and Expositions

June 6-9—

American Society of Mechanical Engineers. Oil and gas power division meeting to be held at Hotel Baker, Dallas, Tex. C. E. Davies, 29 West Thirty-ninth street, New York, is secretary.

June 12-17—

Society of Automotive Engineers. Summer meeting to be held at Greenbrier hotel, White Sulphur Springs, W. Va. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary.

June 13-July 8—

Massachusetts Institute of Technology. Special summer school and conferences on "Strength of Materials," to be held at Massachusetts Institute of Technology, Cambridge, Mass. Prof. John M. Lessells, Department of Mechanical Engineering, Massachusetts Institute of Technology, is director of the summer school.

June 13-15—

National Warm Air Heating and Air Conditioning Association. Semi-annual meeting to be held at Plankinton hotel, Milwaukee. Allen W. Williams, 50 West Broad street, Columbus, O., is secretary.

June 13-17—

American Electroplaters' Society. Annual convention to be held at Hotel Schroeder, Milwaukee. W. J. R. Kennedy, 90 Maynard street, Springfield, Mass., is executive secretary.

June 16-17—

Stoker Manufacturers' association. Annual meeting at the Homestead, Hot Springs, Va. Marc G. Bluth, 307 North Michigan avenue, Chicago, is secretary.

(Concluded on Page 85)

MEETINGS and EXHIBITIONS

(*Concluded from Page* 82)

June 20-22—

Institute of Radio Engineers. Annual meeting to be held at Hotel Pennsylvania, New York. Harold P. Westman, 330 West Forty-second street, New York, is secretary.

June 20-23—

American Heating and Ventilating Engineers. Semiannual meeting to be held at The Homestead, Hot Springs, Va. A. V. Hutchinson, 51 Madison avenue, New York, is secretary.

June 20-24—

American Institute of Electrical Engineers. National annual summer convention to be held at Mayflower hotel, Washington. H. H. Henline, 33 West Thirty-ninth street, New York, is national secretary.

June 20-24—

American Society of Mechanical Engineers. Semiannual meeting to be held at Hotel Statler, St. Louis. C. E. Davies, 29 West Thirty-ninth street, New York, is secretary.

June 27-30—

American Society of Agricultural Engineers. Annual meeting to be held at Asilomar hotel, Pacific Grove, Calif. Raymond Olney, St. Joseph, Mich., is secretary.

June 27-July 1—

American Society for Testing Materials. Annual meeting to be held at Chalfonte-Haddon Hall, Atlantic City, N. J. C. L. Warwick, 260 South Broad street, Philadelphia, is secretary.

Steel Castings Meritorious As Large Parts

(*Concluded from Page* 42)

design demands sometimes make it impossible to avoid a few shrinkage cracks. It is now recognized by engineers that these do not necessarily indicate a defective casting, and that the welding of such a casting is simply a condition inherent with its proper finishing. With the tremendous improvement in welding technique and equipment in the past few years, it naturally follows that a weld in a casting is just as dependable as a weld in any type of welded structure. Combinations of cast and welded structures, the applications of which are increasing by leaps and bounds, are doing much to dispel unwarranted suspicions against welds in castings.

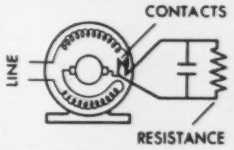
DeVry gets
CONSTANT SPEED
at
ALL VOLTAGES

with this BODINE Governor Motor

The DeVry portable 16-mm sound projector may be connected on a. c. or d. c. The attachment cord may be long or short, and the line voltage high or low. Consequently, the voltage across the motor varies between wide limits. Yet motor speed must be held absolutely constant. DeVry found that a Bodine governor-controlled universal motor gave them unvarying speed under all conditions.

Bodine offers a complete line of electric governor-controlled universal motors that maintain a constant speed at varying voltages and on either a. c. or d. c. These motors can be furnished with or without speed reducers. Write for detailed information and questionnaire. Bodine Electric Co., 2258 W. Ohio St., Chicago.

What is a Governor Motor?



An electric governor motor has a pair of contacts which rotate with the motor and are opened by centrifugal force when the speed becomes too high. This connects a resistance in series with the motor and slows it down until the contacts close again. This is repeated hundreds of times a second and keeps the motor speed constant.

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FRACTIONAL H. P.
MOTORS
ENGINEERED FOR YOUR PRODUCT

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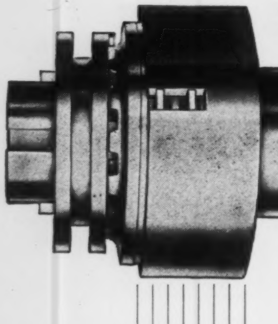
Yes, it's a CONWAY
SLEEVE CLUTCH



...and it can stand plenty of "cuffing" around!

It's smooth and efficient, yet remarkably durable. The Conway sleeve clutch is designed for restricted swing radii and fractional horse powers. Engagement is easy and instant; releases immediately; idles freely. Also built to operate double throw.

FOR A CLUTCH TO MEET ALL YOUR NEEDS, LOOK TO CONWAY

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- HEAVY DUTY
- LIGHT DUTY
- GEAR DRIVEN
- TOOTH DRIVEN

* WRITE FOR CATALOGS L28 & P24 SEND FOR BULLETIN XYZ

The Conway Clutch is patented in U. S. A. and Canada

THE CONWAY CLUTCH CO.
1546 Queen City Avenue
CINCINNATI, OHIO

Compact Pump Adds Space in Dispenser

(*Concluded from Page* 40)

valve unless the supply line is tight. This is important, as a leaky supply line involves losses to the user. Upon starting, the pump momentarily develops enough pressure to open the differential and poppet valve and, if the discharge line is not full, pumps some fuel into it. Such discharge, if not immediately replaced through the inlet, results in a pressure drop and closing of the discharge valve, hence considerable fuel always remains in the pump. This fuel will be re-cycled through the ejector, the settling chamber and float valve to suction chamber as long as the discharge valve remains closed and the pump runs, but with no appreciable loss of fuel and minimum power consumption, as the quantity of fuel pumped is small.

Undelivered Fuel Is Recycled

If fuel enters through the suction line, as during normal operation, delivery will be continuous as long as the hose nozzle is open. When the latter is closed and the power is shut off, fuel is trapped in the outlet system under about six pounds per square inch pressure when the poppet valve closes under influence of the spring. Should the motor continue to run (as it does until the operator shuts off the power in hanging up the hose) after delivery ceases, the only fuel discharged is that passing through the ejector and recycled, as indicated above.

By removing the air or trapped gases in the manner described none can pass out through the meter and accurate measurements are assured without having an independent separating chamber. Although the impeller is quite small in diameter, it runs at high speed and gives ample delivery capacity. Having smooth passages and a smooth exterior surface and no metallic contacts producing friction, power requirements and power losses are low.

Has Few Moving Parts

An important consideration from a maintenance standpoint is that the only moving parts, aside from the impeller, its shaft and the motor armature (in effect, one integral unit) are the valves, and that these are simple and of such a nature as to require no attention over long periods. When the whole dispensing unit involves, in addition to the merits of the pump element, so many commendable features of design, there is little doubt that its makers will continue to maintain the records already set up by its products.

TOPICS

(*Concluded from Page 26*)

been confined largely to blanks for transmission cluster gears and ring gears, resulting in a stronger, lighter and less expensive product. Important advantages are obtained by whirling the dies rather than by pouring the metal into a stationary mold. As explained by R. H. McCarroll, Ford metallurgical engineer, "in centrifugal casting any remaining crystal structure in the metal runs perpendicular to the forces to which the gear teeth will be subjected in actual use. In a forging, on the other hand, the 'flow lines' formed during forging are parallel to the lines of force. Therefore the centrifugally cast steel gear is stronger." Molds are spun at speeds from 600 to 800 R.P.M. The job is expected soon to be put on a production basis.

◆ ◆ ◆

Thirty-three years ago safety glass, which most people think of as a rather new development, was invented by John Crewe Woods. He used tolu balsam adhesive to make a sheet of cellulose nitrate stick between two pieces of glass. But as in safety glass made in more recent years, discoloration and decomposition of the adhesive middle layer plastic were seemingly insurmountable problems. Realizing that 10,000,000 pounds of this material is used a year, chemical manufacturers have been striving to find a new and more satisfactory substitute. Answer to the quest seems to be vinyl acetal resin. It does not become brittle at low temperatures, does not yellow with age and has little tendency to absorb moisture as do the cellulose nitrate products.

◆ ◆ ◆

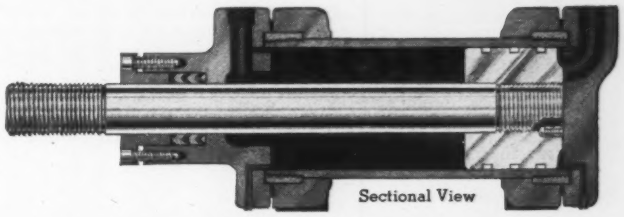
Lightning is a hard subject to have pose for a camera. Yet to make an investigation of the detail characteristics of lightning strokes, a Boys camera has been developed with a rotating film velocity as high as 10,000 feet per minute. A suitable light trap and means for moving the rotating member which carries the photographic film have made it possible to obtain seven successive exposures of lightning without changing the film. Photographs of many strokes have been obtained and valuable analyses made.

◆ ◆ ◆

Five times as much type can be set on a modern linotype machine as a printer working by hand could set in 1890, yet the number of typesetters employed today is five times greater than 40 years ago.

Hydraulic Power

Advantages **plus**



Sectional View

Simplicity, ease of application, and flexible control of power movements are hydraulic cylinder advantages that are reinforced by the design of Hannifin high pressure hydraulic cylinders. Their new type, patented construction is stronger, simpler, and easier of application to modern equipment. High efficiency hydraulic power and ability to withstand severe service are assured.

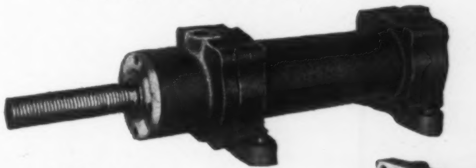
NO TIE RODS. This simpler design is stronger, and eliminates a source of leakage. End caps may be removed without collapse of other parts of the assembly.

UNIVERSAL CAPS. Either end cap may be positioned independently, so that inlet port is at top, bottom, or either side. Either cap may be moved without disturbing the cylinder mounting or other parts.

AIR VENT PLUGS. Each end cap has air vents on three sides. With the inlet port at either side or bottom there is always an air vent plug at the top.

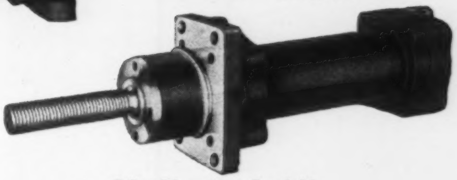
LEAK-PROOF. Special mirror finish honing produces a cylinder bore that is straight, round, perfectly smooth, and concentric with the end caps. A perfect piston seal is obtained.

MANY TYPES AND SIZES. Available in six standard mounting types, with small diameter piston rod, 2 to 1 differential piston rod, or double end piston rod, in all sizes, for working pressures up to 1000 and 1500 lbs./sq. in. Other types built to order.



Model CN

Model JN



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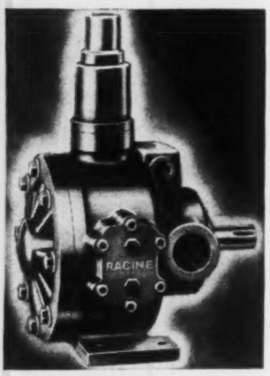

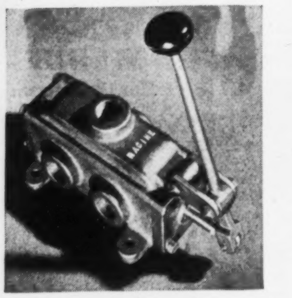

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MANUFACTURERS' PUBLICATIONS

ALLOYS (STEEL)—Fabrication of stainless steels, including welding, riveting, soldering and the design of joints are explained and discussed in an extensively illustrated booklet (Part 1) prepared by Carnegie-Illinois Steel Corp., 434 Fifth avenue, Pittsburgh.

BEARINGS—Catalog No. 35A gives complete specifications and construction details of ball bearings and heavy duty roller bearings made by The Fafnir Bearing Co., New Britain, Conn.

BEARINGS—Oilite oil cushion, precision bronze bearings made by the Chrysler Corp. and distributed by Boston Gear Works, Inc., North Quincy, Mass., are described and specifications given in a leaflet prepared by the latter company.

BEARINGS—"Precision Needle Roller Bearings and Needle Rollers" is the title of bulletin No. 962, issued by Norma-Hoffman Bearings Corp., Stamford, Conn. Specifications and application drawings are included.

BELTS—Technical details of the functions and construction of the Condor Whipcord V-belt are described in an attractive four-page bulletin (No. 6868) issued by The Manhattan Rubber Mfg. Division of Raybestos-Manhattan Inc., Passaic, N. J.

CHAINS—Practical information, application pictures and engineering data on Silverlink roller chain and sprockets for drives and conveyor uses are contained in data book No. 1757, just issued by Link-Belt Co., Indianapolis.

CHAINS—Compiled in data book form, booklet prepared by Chain Belt Co., Milwaukee, gives complete exposition of development, design and use of Rex Oil Well chains. Strengths, sizes and other specifications are included.

CONTROLS (ELECTRICAL) — Several pamphlets have been issued by the General Electric Co., Schenectady, N. Y., describing new electrical equipment developed by the company. Among these are GEA-19H, covering alternating current motor-starting switch; GEA-2234B on manual motor starting switch for control of fractional horsepower motors; GEA-2908, describing the new oilproof pushbutton and selector switch; GEA-1437C, covering gearmotors from ⅛ to 75 horsepower; GEA-1542C, giving information on type B direct current motors; GEA-2889, covering the magnetic motor-starting switch, and GEA-2052A on the new track-type limit switch for use in automatic control circuits.

CONTROLS (ELECTRICAL)—Data and general specifications on a new midget magnetic relay introduced by Ward Leonard Electric Co., Mount Vernon, N. Y., are contained in bulletin 106.

CONTROLS (ELECTRICAL)—Folder describing the new Cam-O-Tractor control for industrial trucks and similar equipment has been issued by The Yale & Towne Mfg. Co., Philadelphia.

CONTROLS (ELECTRICAL) — Type A safety switches of the quick-make and quick-break type are described and specifications given in bulletin No. 1184, issued by The Electric Controller & Mfg. Co., 2700 East 79th street, Cleveland.

DRIVES—Complete line of pulleys and flexible couplings are described, list prices given and general engineering data included in a folder of Congress Tool and Die Co., Detroit.

ENGINEERING DEPARTMENT EQUIPMENT—Drawing board covers, straight edges, parallel rule attachments, erasing shields and other drafting supplies are described in a folder of Engineering Sales Co., Two Rivers, Wis.

ENGINEERING DEPARTMENT EQUIPMENT — Wall chart, 22 x 35 inches, has 249 engineering and architectural symbols, alphabetically arranged, which will be sent to members of engineering or architectural organizations or firms. It is available through The Frederick Post Co., 208 South Clark street, Chicago.

FASTENINGS—Leaflet of Hopkan Rivet Co., Inc., 129 Latham street, Pittsburgh, describes a new self-locking rivet introduced by the company. Various applications are illustrated.

GEARMOTORS—Various types and specifications of motoreducers are covered and applications illustrated in bulletin MR 36 of Philadelphia Gear Works, Phila., Pa.

GEARS—Complete listing of standard gears, standard worms and worm gears, safe tooth loads and horsepower ratings and other complete specifications are given in general catalog No. 37, issued by The Horsburgh & Scott Co., 5114 Hamilton avenue, Cleveland.

LIGHTING—Transformers, designed to be built into machines to reduce line voltage for machine lighting requirements are described in bulletin 23-1 of American Transformer Co., 178 Emmet street, Newark, N. J.

LUBRICATION EQUIPMENT—Manzel Brothers Co., 311 Babcock street, Buffalo, have issued catalog 94-B illustrating and describing the "Model 94" force feed automatic lubricators for engines, pumps, compressors and bearings in all types of industrial machines.

MOTORS—Construction details of direct current motors (Fairbanks, Morse & Co., 900 Wabash avenue, Chicago) in their various sizes are described and illustrated in bulletin 2260, prepared by the company.

OIL SEALS AND PACKING—The new "Split-Klozure" bearing seal which may be slipped around a shaft instead of over the end, eliminating the need for taking machinery apart is described in a folder of The

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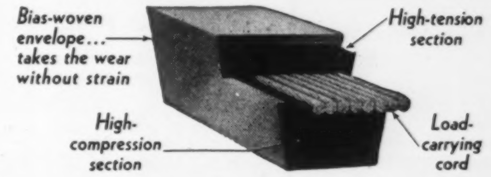

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